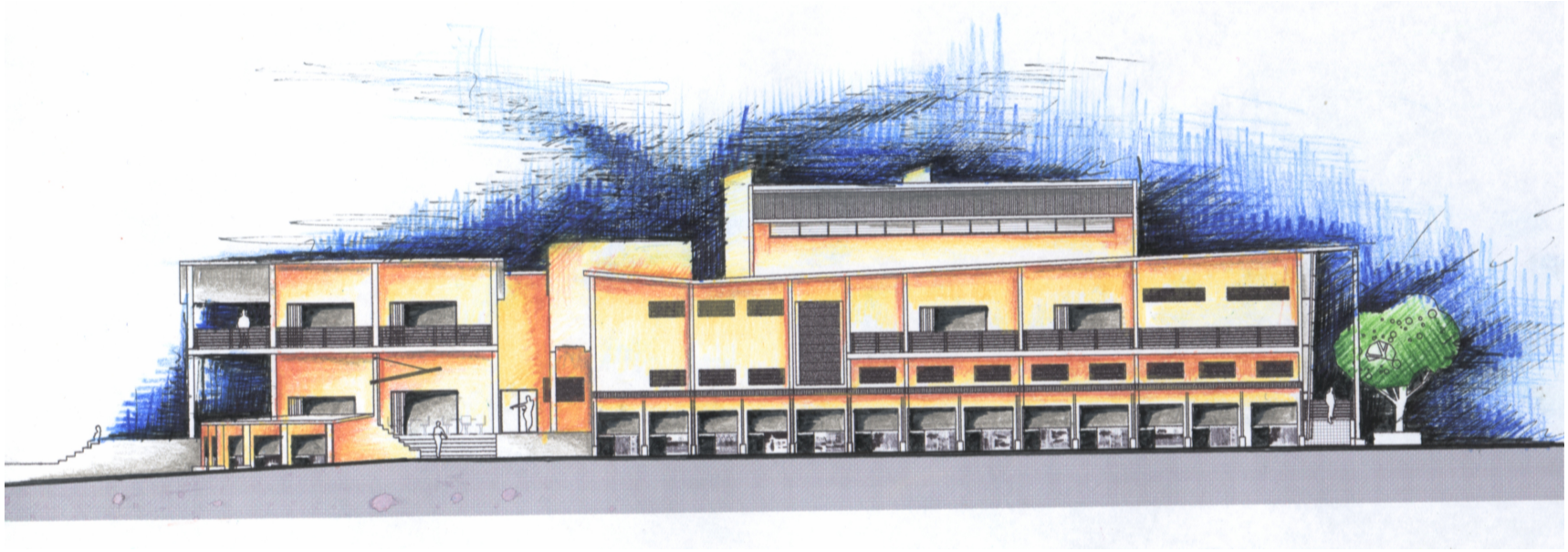


A mixed-use development with the focus on dance activities with supporting educational and trading facilities, Newtown.

by

Helia Potgieter

Submitted in fulfilment of part of the requirements for the degree of **Magister in Architecture (Professional)** in the **Faculty of Engineering, Built Environment and Information Technology, University of Pretoria,** Pretoria, South Africa.

November 2003

"Take me to the places on earth that teach you how to dance,
the places where you can risk letting the world break your heart,
and I will take you to the places where the earth and the stars
make my heart whole again and again."

(Lund, 2002:65)

Summary:

This dissertation contains the design for a mixed-use development with the focus on dance activities with supporting educational and trading facilities. The vision of this design proposal is to create a new urban citizenship to establish a development that will contribute to the process of urban regeneration in the inner city of Johannesburg.

"it is an endless repetition of urban disorder- deterioration, pollution, filth, decay, waste, illegal immigrants, violence and crime, anarchism- is a coded way of talking about the arrival and presence of non-whites in the inner city, and particularly groups considered to be marginal, the street vendors, the parking attendants, the homeless." (Sandercock, 2000)

The face of Johannesburg's inner city has undergone rapid change in its socio-economic make-up in the past few years. This change is clearly visible in the urban explosion, social fracture, environmental degredation, escalating crime, violence and grinding poverty. This urban reality is part of an ongoing set of evolutionary processes that began since the genesis of Johannesburg. If we seek to provide any form of urban regeneration in the inner city we need to understand the underlying issues of what really exist on the inner city streets.

"Official urban discourses (those produced by local councils and planning departments) tend to legitimize and privilege the fears of the bourgeoisie, their fears of those "others" who might invade or disrupt their homely spaces, their habitus. We rarely hear from those folks whom official discourse classifies as "others" about their fears: the fear for example of being hungry, homeless, jobless, of having no future in the city, of being unable to provide for one's children, the fear of not being accepted in a strange environment, the fear of police or citizen violence against them." (Sandercock, 2000)

The process of regeneration must begin at community citizen level, the citizens who live and work in Johannesburg, who suffer the most from crime, poverty and declining land values because of the flight of businesses from the CBD. Being a citizen of a city involves having certain rights and obligations. These are based on the ideas of justice, equality and community. (Crest, 2000:16) The cultures and sub-cultures that exist in Johannesburg are immense. The city has truly become a multi-cultural city with a wide spectrum of citizens seeking hope for a better future.

"Post-modernism emphasizes the benefits of diversity, it welcomes the growth of localized protest as a means of promoting democracy, and it opens up the planning process in a way which is typically denied by an emphasis on technical rationality"(Goodchild, 1999)

Post-modernism is concerned with the end of homogeneity. This concept of multiplicity concerns itself with the setting of precedence for an inclusive, pluralistic society. South Africans need to celebrate the diversity and plurality of our rich culture. This new way of thinking needs to be seen in the Johannesburg context. A city has the responsibility to provide its inhabitants with the necessary opportunities for social and economic development. This multi-cultural dynamic force has the potential to shape the city. Dance, in all its multi-cultural manifestations, is used as the universal tool for urban regeneration.

Current urban regeneration schemes in the inner city had a direct influence on the design. The development vision is based on creating a human-scaled, active and vibrant public environment within a milieu of art and cultural activities, with supporting retail, business, and educational and residential uses as stated in the Newtown Cultural Precinct Urban Design Plan.

The development is situated in the Newtown cultural precinct and forms an important part of the interlinked public environmental system by establishing the dominant east-west redevelopment corridor running past the Turbine Hall.

The broad aims of the project are:

- Establish a mix of compatible uses within the precinct and a multi-functional city center.
- Ensure that street space is a public amenity by creating
  - active ground floor uses
  - attractive environments
  - variety of activities and multiple uses of streets
  - externalizing activities in buildings
  - enable pedestrian orientated activities
- Provision of a wide range of social and cultural amenities
- Establish a strategy for historic vacant buildings, like the Turbine Hall.

Hierarchy of space division was essential as a result of multiple uses in the building. Public and more private zones are identified. This ensures informal areas for social interaction of the public and security for the students.

Visual form dynamics and the principles of rhythm in human movement served as inspiration for he development of the concept and details for the design. Dance and architecture are related forms of art which involve related basic principles of rhythm. Both of them use a combination of energy, space and dynamics to create a harmonious totality.

Johannesburg has been since its history a dynamic city in transition. The city is a diverse mosaic of urban life. A new urban citizenship, Multi-culturalism and social equity can provide Johannesburg with the extraordinary opportunity of reinventing itself to a united city of hope.

Opsomming:

Die skripsie behels die ontwerp van 'n gemengde gebruik ontwikkeling met die fokus op dans aktiwiteite met ondersteunende opleidings- en handelsfasiliteite. Die visie van die ontwerpvoorstelling is die skepping van 'n nuwe stedelike burgerskap om sodoende 'n ontwikkeling daar te stel wat sal bydra tot die proses van stedelike regenerasie in die middestad van Johannesburg.

"it is an endless repetition of urban disorder- deterioration, pollution, filth, decay, waste, illegal immigrants, violence and crime, anarchism- is a coded way of talking about the arrival and presence of non-whites in the inner city, and particularly groups considered to be marginal, the street vendors, the parking attendants, the homeless." (Sandercock, 2000)

Die voorkoms van die middestad van Johannesburg het 'n snelle metamorfose ondergaan ten opsigte van die sosio-ekonomiese samestelling gedurende die afgelope jare. Die verandering is duidelik sigbaar in die stedelike uitbreiding, sosiale verval, omgewings-agteruitgang, toenemende misdaad, geweld en drukkende armoede. Hierdie stedelike realiteit vorm 'n integrale deel van 'n reeks van voortdurende evolusionere prosesse wat begin het sedert die onstaan van Johannesburg. As ons enige vorm van stedelike heropbou nastreef is dit noodsaaklik dat ons in die onderliggende aspekte, van wat werklik bestaan in die middestad, verstaan.

"Official urban discourses (those produced by local councils and planning departments) tend to legitimize and privilege the fears of the bourgeoisie, their fears of those "others" who might invade or disrupt their homely spaces, their habitus. We rarely hear from those folks whom official discourse classifies as "others" about their fears: the fear for example of being hungry, homeless, jobless, of having no future in the city, of being unable to provide for one's children, the fear of not being accepted in a strange environment, the fear of police or citizen violence against them." (Sandercock, 2000)

Die proses van stedelike regenerasie moet begin by die burgerlike gemeenskapsvlak, by die inwoners van die stad wat in Johannesburg leef en werk, die wat die meeste blootgestel word aan misdaad, armoede en die afnemende waarde van eiendom as gevolg van die uittog van besighede vanuit die sentrale besigheidsdistrik. Daar is 'n wye verskeidenheid van kulture en sub-kulture in Johannesburg. Die stad het waarlik ontwikkel in 'n multi-kulturele samelewing met 'n wye spektrum van inwoners wat streef na 'n hoopvolle toekoms.

"Post-modernism emphasizes the benefits of diversity, it welcomes the growth of localized protest as a means of promoting democracy, and it opens up the planning process in a way which is typically denied by an emphasis on technical rationality"(Goodchild, 1999)

Die konsep van post-modernisme vereis die einde van homogeniteit. Hierdie teorie berus op die daarstelling van 'n presedent van 'n insluitende pluralistiese samelewing. Suid-Afrikaners moet die diversiteit en pluraliteit van ons ryke kultuur herdenk. Hierdie nuwe denkwyse moet gesien word in die konteks van Johannesburg. Dit is die verantwoordelikheid van 'n stad om sy inwoners van die nodige geleenthede te voorsien vir sosiale en ekonomiese ontwikkeling. Die multi-kulturele dryfkrag het die potensiaal om die stad gestalte te gee. Dans, in al sy multi-kulturele fasette, word aangewend as 'n universele werktuig van stedelike regenerasie.

Huidige stedelike hernuwings-voorstellinge in die middestad het 'n direkte invloed op die ontwerp gehad. Die doel van die ontwikkeling is gebasseer op die daarstelling van 'n bedrywige en aktiewe publieke omgewing wat op 'n menslike skaal gefokus is. Hierdie ontwikkeling vind plaas in 'n kulturele milieu met ondersteunende kleinhandel-, besigheids-, opleidings- en residensiele gebruike soos uiteengesit in die Newtown Cultural Precinct Urban Design Plan.

Die projek is gelee in die Newtown kulturele distrik en vorm 'n integrale deel van die noue samestelling van die publieke omgewing. Die ontwerp vorm deel van die dominante oos-wes herontwikkelingstrook wat voor die Turbine Hall verbyloop.

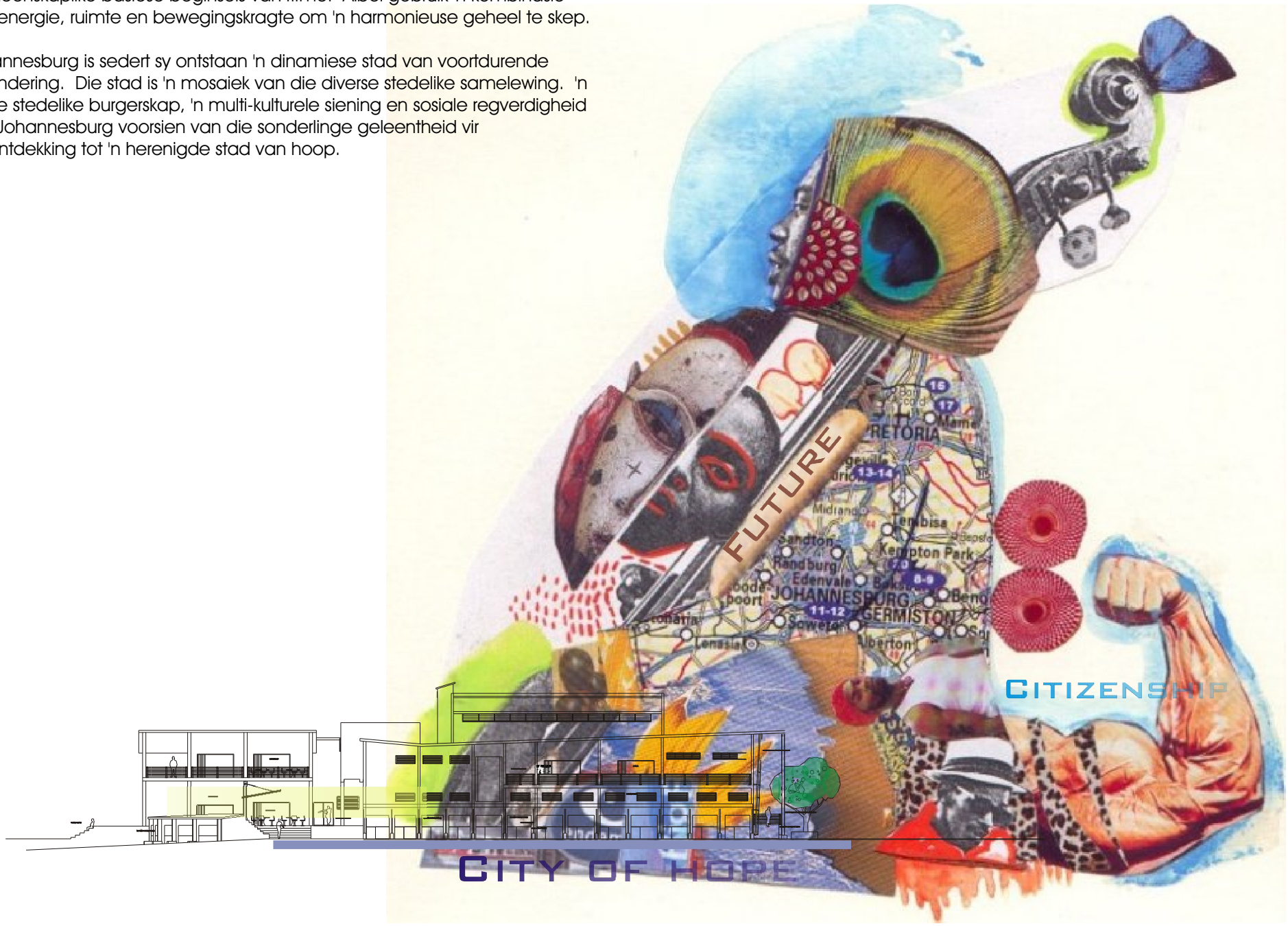
Die bree doelstellings van die projek is as volg:

- Die daarstelling van 'n mengsel van aanpasbare gebruike binne die Newtown distrik en die multi-funksionele stadskern.
- Om te verseker dat straatruimtes 'n publieke kommoditeit word deur:
  - aktiewe grondvloer gebruik;
  - aangename publieke omgewingstoestande
  - verskeidenheid van aktiwiteite en veelvuldige gebruik van straatruimtes
  - om aktiwiteite binne die gebou na buite te bring
  - verseker voetganger-georienteerde aktiwiteite
- Verskaffing van 'n verskeidenheid sosiale en kulturele fasiliteite.
- Die skepping van handel- en werkverskaffingsgeleenthede.
- Die daarstelling van 'n gebruikstrategie van onbesette historiese geboue soos die Turbine Hall.

Hierargie van ruimteverdeling was belangrik as gevolg van die veelvuldige aktiwiteite binne die gebou. Publieke en meer private sones was geidentifiseer. Informele ruimtes vir sosiale interaksie vir die publiek en sekuriteit vir die studente word hierdeur verseker.

Die studie van dinamiese visuele vorm en die beginsel van ritme in menslike beweging het gedien as inspirasie vir die ontwikkeling van die konsepte en details van die ontwerp. Dans en argitektuur is verwante kunsvorme met gemeenskaplike basiese beginsels van ritme. Albei gebruik 'n kombinasie van energie, ruimte en bewegingskragte om 'n harmonieuse geheel te skep.

Johannesburg is sedert sy ontstaan 'n dinamiese stad van voortdurende verandering. Die stad is 'n mosaiek van die diverse stedelike samelewing. 'n Nuwe stedelike burgerskap, 'n multi-kulturele siening en sosiale regverdigheid kan Johannesburg voorsien van die sonderlinge geleentheid vir herontdekking tot 'n herenigde stad van hoop.



Museum Africa, Market Theatre	050	Fig 78. The Market Theatre Precinct Fig 79. The Market Theatre (Market Theatre,, 2002)
Nelson Mandela Bridge	051	Fig 80. Unveiling of the model of the Nelson Mandela Bridge (Nelson Mandela Bridge, 2002) Fig 81. A news article in Rapport on the Nelson Mandela Bridge (Eybers, 2003:) Fig 82. The M1-Carr Street interchange.
Metro Mall, new housing development	052	Fig 83. The Metro Mall during construction (Thale, 2002) Fig 84. Colourful murials at the Metro Mall (Majavu, 2002) Fig 85. The new housing development (Housing Development, 2002)
Views	053	Fig 86. View towards the east. Fig 87. Location of viewpoints. Fig 88. View up into Kerk Street. Fig 89. View towards the south-west. Fig 90. Location of viewpoints. Fig 91. View south into West Street. Fig 92. View to east across plaza. Fig 93. Location of viewpoints. Fig 94. View to north-east up in West Street. Fig 95. View to west across plaza. Fig 96. Location of viewpoints.
Topography	057	Fig 97. Square metre area of the site. Fig 98. Site falls with slope of 1.8 towards the west. Fig 99. Site sections.
Macro-climate	058	Fig 100. Statistics on temperatures and rainfall in Johannesburg, 2002 (South African Weather Services: average climate statistics for Johannesburg, 2002)
Micro-climate	059	Fig 101. Site climate.
Sun angles and shading	060	Fig 102. Shade on 21 December, 08:00. Fig 103. Shade on 21 December, 12:00 Fig 104. Shade on 21 December, 16:00. Fig 105. Solar times, azimuth and altitudes of Johannesburg (Napier, 2000:4.10) Fig 106. Shade on 21 June, 08:00. Fig 107. Shade on 21 June, 12:00 Fig 108. Shade on 21 June, 16:00. Fig 109. Solar times, azimuth and altitudes of Johannesburg (Napier, 2000:4.10)
Urban design guidelines	062	Fig 110. Urban design guidelines
Movement	063	Fig 111. Pedestrian barrier. Fig 112. Movement
Precedent studies: Cato Manor Development Project, Durban, 1994.	064	Fig 113. The Cato Manor development (Cato Manor Development Project, 2002) Fig 114. Participants in a course for emerging entrepreneurs (CMDA Status Report 2000, 2002) Fig 115. Cato Manor (CMDA Status Report 2000, 2002) Fig 116. The Cato Manor development (Cato Manor Development Project, 2002) Fig 117. Plan of the multi-functional centre (Kaplan, 2000:5) Fig 118. Section through the multi-functional centre (Kaplan, 2000:5) Fig 119. Public buildings: the Wiggins-Umkhumbane multi-purpose centre Kaplan, 2000:5) Fig 120. The Bellair Market and Urban Park (Kaplan, 2000:7) Fig 121. The Bellair Market (Kaplan, 2000:7) Fig 122. Public buildings: the Bellair Centre (Kaplan, 2000:7) Fig 123. The school has outside teaching spaces provided with seating and a

The Client: Gauteng Provincial Government and the Blue IQ initiative:

The development of Newtown is one of ten projects under the Gauteng Provincial Government's Blue IQ initiative, which is responsible for the implementation of a number of infrastructure development projects in the province. The Gauteng Provincial Government's aim with this project will be to regenerate and revitalise the inner city of Johannesburg. Working with the Johannesburg Development Agency (JDA), a development agency of the City of Johannesburg, Blue IQ is contributing a total of R258 million towards the development of Newtown. The Newtown area had degenerated into a derelict slum in recent years, but its redevelopment is one of the most visible of the Blue IQ projects. The master plan for Newtown is for it to become a hub of cultural, artistic, and creative industries with a series of permanent cultural attractions and tourism draw cards. It will also become a thriving mixed-use retail, a residential area and a transport node.

Other Newtown developments underway include the construction of hospitality facilities as well as a state of the art security and lighting system. The Nelson Mandela Bridge, linking Braamfontein and Newtown, which was recently completed,and the M1/Carr street interchange on and off ramps will dramatically improve accessibility into the area.

The strategy of Blue IQ to attract a critical mass of people to the Newtown area, whether it is the local community or tourists, involves the creation of additional developments like a multi-media and film centre, a national craft and design centre, a science and technology centre and a new dance venue. The Dance Factory is currently the only dance venue operating in the area and as a result of the enormous demand for more performance spaces and studios, a new multi-functional dance centre is critical in satisfying this demand.

One of the most important aspects in attracting visitors to the area is increasing safety and security of the Newtown area in general. This will involve providing additional cleaning and upgrading of the public environment. The lighting of Mary Fitzgerald Square will further enhance the attractiveness of the area, but also contribute to the use of the inner city as a 24 hours a day destination.

Other interested parties: The Johannesburg Development Agency:

The Johannesburg Development Agency (JDA) is an initiative of the City of Johannesburg Metropolitan Council (CJMC), and has been established as a Proprietary Limited Company (Pty Ltd). Design work of the Johannesburg Development Agency began in March 2000, and its establishment was approved at the City Council in October 2000. The City Council Mayoral Committee confirmed the establishment of the Johannesburg Development Agency in January 2001. The Gauteng Provincial Government is a key stakeholder in Johannesburg's regeneration efforts and major source of development finance to the Johannesburg Development Agency. (JHB Development Agency, 2002)

The vision of the Johannesburg Development Agency is to drive developments that will contribute to achieving Johannesburg's potential as the African World Class City a city of prosperity, excellent quality of life and a wealth of cultural and economic opportunity. (JHB Development Agency, 2002)

The mission of the Johannesburg Development Agency is to initiate, promote and implement activities that lead to increased economic development in the city. As the focus for city policies on developing its target areas, the JDA and its partners will deliver a range of projects and programmes aimed at creating jobs and wealth for Johannesburg and its citizens. These activities are the 'products and services' of the JDA. The 'product' of the JDA will be the successful delivery of a project against its defined plan and objectives. The 'service' provided by the JDA will be the effective management of its programme of projects. The JDA will add value by linking efforts, integrating services to projects and programmes and, thereby, achieving true efficiencies.

The Johannesburg Development Agency's initial project portfolio and programmes fall into four defined groups:

• Special Activity Precincts: The development of the precincts at Constitution Hill and Greater Newtown will be flagships of the Johannesburg Development Agency's project programme in terms of their national and international profile, levels of public and private investment, and contribution to boosting confidence and image in the City Centre. The development the mixed-use development falls into this program.

Fig 1. The Blue IQ Initiative

• Urban Regeneration Projects: The widespread recognition of the need to revitalise the Inner City is evident in the recent production of the Inner City Spatial Development Framework (1999) and the City Centre Framework (2000). Both frameworks call for coordinated implementation, led by catalytic projects and targeted interventions. The Johannesburg Development Agency is above all the implementing agent to ensure that there is follow-through on priority actions identified in these frameworks. The development of Newtown as a successful urban environment will be directed by the Johannesburg Development Agency.
• Financial Instruments: The Johannesburg Development Agency will utilise a range of financial instruments to support its project and business enterprise activities. Co-operation with Business Arts South Africa will ensure the success of a new dance centre.
• Support Programmes: The Johannesburg Development Agency will implement a range of programme activities that provide support projects and help create a more developmental environment for investment in its target area. These include project marketing, public and community relations; strengthening the development environment and business support; encouraging environmentally sustainable development.

The projects and programmes of the Johannesburg Development Agency will be detailed in an annual work plan, in line with the business plan that will be adopted by the Johannesburg Development Agency Board. This mechanism ensures that City of Johannesburg Metropolitan Council has the opportunity to influence Johannesburg Development Agency annual programmes, and ensures oversight and accountability on performance.

International experience over the past 20 years shows that cities are actively pursuing growth strategies through development agencies and joint coalitions between the municipality, local business leaders, developers and other relevant stakeholders. A city must actively be involved in creating the conditions for growth. One form of this active involvement is the creation of particular agencies like the Johannesburg Development Agency to initiate and facilitate growth.

The Johannesburg Development Agency is able to use technical expertise from the City of Johannesburg Metropolitan Council and other organisations via service level, agency and other agreements. The agency also has access to an outsourced pool of technical assistance or specialists on a term contract basis. This will enable the Johannesburg Development Agency to put together 'fit-to-purpose' project teams. Specialist areas include:

·- Planning/architecture/urban design.

- Quantity surveying

- Legal.

- Marketing/communications.

- Transport planning

- Finance and accounting.

- Property management and development.

- Cultural, heritage and creative industries specialists.

This pool comprises a pre-qualified list of contractors in each of the listed areas, drawn up against progressive procurement principles as well as technical merit. The pre-qualified list will be reviewed annually. The Johannesburg Development Agency has the power to appoint pre-qualified contractors for any work without having to go through a full-fledged tendering process each time a service is needed.

Blue IQ Means Business Week and Business and Arts South Africa:

Blue IQ has established a business outreach programme: the Blue IQ Means Business Week. The week is aimed at collaboration between government and business to drive Gauteng's economy forward. During the week Blue IQ presents in detail the many investment opportunities to local and international business available in the Newtown project. Public Private Partnerships become the main drivers for achieving Blue IQ's goals. Blue IQ presents a product in the hope to create a long-term relationship between a business and a Blue IQ project.

Business and Arts South Africa (BASA) supports the Gauteng Provincial Government's and the Johannesburg Development Agency's plan to use the arts as a tool for urban regeneration. BASA came out in the support of the Gauteng Provincial Government's plan to build a broad arts, culture and entertainment arc, stretching from Braamfontein to Newtown. BASA was launched in 1997 to develop and promote sustainable business-art partnerships that would benefit communities. Its patron is Thabo Mbeki. The organization has members like BMW, Primedia, Airport companies, Anglo American, Vodacom, MTN and KPMG.

The arts can present a viable and effective communications tool for business. Arts sponsorship can form an integral part of marketing or promotional strategy. The arts can increase awareness of a brand or enhance corporate image. The arts also have a capacity to sustain associations over the long term. The more a company engages in a project over a sustained period, the greater the value extracted. The members of BASA will be responsible for the funds needed in the utilisation of the building. Apart from money gained from performance spaces and studios rented out to companies, these members will contribute to the up-keep and running of the building.

One of the strategic programmes of the Blue IQ Means Bussiness Week will be the Blue IQ Smart Young Minds Challenge aiming at encouraging Gauteng school learners to contribute and participate in the creation of a smart province. Students who qualifies for the courses presented at the centre will be nominated by their teachers and "adopted" by the members of BASA, who will give the student a bursary. Underprivileged students gain the opportunity to follow careers in professional dancing, choreography and stage design.

European Union:
The project will received substantial funding from the European Union as part of the European Union's Programme for Reconstruction and Development in South Africa. Sustainability and replicability are the main guiding principles behind the European Union's investment in the project. The focus is therefore on providing commercial infrastructure as well as much needed social facilities such as schools, sports fields, administrative facilities and community halls. At the same time European Union-funded projects are delivering capacity building, skills training and support programmes, thus creating opportunities for residents to enter the job market or establish their own businesses. These are the main reasons why the European Union will fund a project like this, because this project lends itself to providing these much needed opportunities for Johannesburg's citizens.

The users:

Johannesburg CBD has people: It has 217 000 residents in 37 000 dwelling units, 800 000 commuters enter the city every day, and 300 000-400 000 migrant shoppers visit the city each year. (City Development Plan 2001/2003. 2002) The function of a building should integrate the various sectors of a community surrounding it. A rich diversity, not only in users, but also in function of the building should be created.

To achieve this diversity in utilization, the building needs to function as a community centre of sort that cater firstly for the immediate and direct users of the area. Performances, festivals, exhibitions, classes and outreach programmes will be available for each and every person who has a passion for dance and the performing arts, not only for rich people living in upmarket suburbs, who can afford the tickets bought at a typical formal theatre, but also for the simple man walking the streets of the city. The goal is to provide a 'drop-in-theatre' service. A range of events and activities will be created at low cost. This diversity in users will ensure a rich, innovative cross-cultural environment where people of every race, creed and culture will come together to celebrate the art of dance, whether as an observer or a participant. Such a project that celebrates South Africa's cultural diversity will also provide a services as a tourist attraction to the global society.

Various integrated activities involving rhythm and movement will be held at this multi-functional centre, from performances in informal and unusual settings, to programmes involving the youth, adults, the elderly and the disabled. Performances will be held inside and outside the building, integrating the public environment with the functions inside the building and drawing people in from the street to participate in the activities. Students will attend short courses in dance and choreography, with the provision of dance studios, an Internet cafe, student housing and education centres. Adult education classes and recreational dance classes will be held as evening activities. Dance performances should not only be undertaken by the young, fit and able-bodied: special programmes will be held for the disabled and the elderly. People must be given choices and be free to come and go as they please with no interference our constraint.

The utilization of the building should also not only be diverse in users and function but also in the times of utilization. The uses in the building would be of such a nature that it would facilitate a 24-hour use of the public environment. During the day time most town centres are busy and crowded; people feel a sense of each other and their own visibility, yet by 6pm it all seems to disappear. What should be among the most vital meeting places in our cities after dark, are uncared for and disliked by their users. Streets and public places are places of assault, fighting, drunkenness and theft. The majority of people find them very threatening places, particularly at night. Such areas have to be policed, regularly, otherwise they simply are not safe for those who are obliged to be there. During the day city streets are full and lively with people. People feel more save and secure even if they are among strangers. A mix of uses active during after dark hours is essential to attract a variety of users to the area and to ensure liveliness and therefore safety. Public safety is then kept by the mass of people using the public environment and not the police. A well-used street is also likely to be a safe street.

Dance:

So much of our universe is in motion. In outer space, planets circle the sun, our own planet, the earth, turns upon its own axis a pattern of motion that is repeated within each atom, where spinning electrons circle a nucleus of protons and neutrons. In this cosmos of perpetual motion, our bodies naturally and instinctively react to situations through movement before we verbalize a response. We shrink with fear or throw up our hands in surprise. Life itself is movement.

No wonder then, that one of the oldest of the arts is the art of movement dance. Rhythm is a fundamental of dance. We might say that movement plus rhythm equals dance. [Barniel, 1987:89] The impulse to dance, to express emotion through movement dates back from the very beginning of man's existence on earth. From the earliest times man has used language as his basic form of communication, a system whereby words have a meaning understood by all within an ordered grammatical framework. The failure of words to express certain meanings has led to the development of non-verbal communication systems whose purpose is to assist and extend comprehension of aspects of experience. The performance art and music each extend our understanding of the world in ways not possible with language. Architecture also gives meaning to aspects of life that cannot adequately be conveyed by words. It may even have been the first means of communication.

Dance's origins are rooted in the prehistoric past, far long before dance grew to be a complex art. Early man took pleasure in swaying, turning, stepping, and stamping rhythmically. Aware of the movement of the powerful forces of nature, early man moved in ways he hoped would appease those forces or give him power over them. Hunters danced before pursuing their quarry, warriors danced before battle, tribes dance to exorcise evil spirits and to propitiate the gods. There were dances to bring rain, dances to celebrate the harvest, dances of birth, puberty, marriage, and death.

Each of the world's great civilizations has produced its own dances. In one sense, all have been similar, since all have made use of the body in motion. Dance forms have varied enormously from culture to culture because the bodies can move in so many ways. Dance is depicted in the earliest paintings and sculptures, but only in static poses. We can only imagine how the dancers moved from one pose to another.

Dance is movement that has been organized so that it is rewarding to behold. The craft of making and arranging dances is called choreography. Out of all the possible movement combinations that exist, the choreographer selects, edits, heightens, and sharpens those he thinks are suitable for his specific purposes. The gestures in some dances may refer to specific emotional states and their sequence may tell a story. Other dances tell no story, but instead present beautiful images of people in motion. Because dance can assume so many guises, the viewer should regard each dance he sees with fresh, unprejudiced eyes. All dance styles are not alike, and some, to the uninitiated, may look decidedly odd.

Dance can exist in its own right without any musical accompaniment choreographers sometimes create ballets, which are performed in silence with the dancers creating their own rhythm which dictates the structure of the work. Some dances are set to sound effects or to literary recitations. Similarly, scenery and costumes may contribute to a work's effectiveness, but some dances require nothing more than simple costumes and a bare stage.

The fundamental appeal of all dance performances is that of seeing everchanging shapes. Dancers inhibit space and time simultaneously, and the interest of a dance derives from the space they use and the time they take, from the positions of their bodies, from their energy, dynamics, and the way their steps are rhythmically organized into units of effort and rest. [Anderson,1974:9] Dancers may cover great territory or huddle in a corner. They may run, leap, turn, dart, glide, or amble; their movements may seem light or heavy, large or small, taut or slack, quick or languid.

From all this activity and interactivity the dance is born. Whether it tells a story, preaches a message, or conjures a mood, dance communicates because it prompts a response within us. Dance is not simply a visual art, it is kinesthetic as well: it appeals to our inherent sense of motion.

Fig 2. FNB Dance Umbrella, 2003.

Fig 3. FNB Dance Umbrella, 2003.

Fig 4. FNB Dance Umbrella, 2003.

Dance in Johannesburg:

Dance can be seen as a universal language that brings together people of every race and culture. In South Africa many of the barriers of apartheid legislation have fallen and the old form of government disappeared. A new crises of identity has evolved which allows space for intense debate and the flowering of new innovative and creative by the people of the post-apartheid culture. South Africans dance to express their bitterness, frustration and hope for the future. South Africans stands at the dawn of a new multi-cultural society where black Africans borrow European movements, the white South Africans borrow black African movements. Ideas are borrowed from a variety of influences, but it gets filtered through the personality and the temperament of the person who is making the work. Movements from other cultures are adapted and transformed through this process to produce a uniquely South African dynamism.

From *gumboot* and *gumba-gumba,* to township jive and *lang-arm* in the suburbs, Johannesburg has a fusion of different dances. Contemporary dance of South Africa can be seen in a variety of dance projects, like the FNB Dance Umbrella Festival and the Vuyani Dance Theatre Project.

The FNB Dance Umbrella is a celebration of dance, which captivates the attention of dancers, choreographers and audiences across our country. Five years ago the FNB Dance Umbrella commissioned up to ten South African choreographers to premier a new work during the festival. Over the years the FNB Dance Umbrella has provided a platform for young dancers, bringing audiences innovative dance works, which reflects the many cultures and traditions of South Africa. This dance explosion is usually held at venues like The Wits Theatre, The Dance Factory and the Nelson Mandela Theatre. Partners of the Festival who makes this event possible is, firstly, First National Bank. Others include The French Institute of South Africa, The British Council, Pro-Helvetia and The Royal Netherlands Embassy.

Various artists formed part of the FNB Dance Umbrella 2003. One of these is the Siwela Sonke Dance Company from Durban who performed the intriguing piece named *Cityscapes.* The piece portrays the idea of architecture and public spaces that are redolent with the imprints of people accumulated over the years. Spaces shape the movement of people who in turn shape those spaces. *Cityscapes* introduced a new kind of performance artist emerging on the dance scene. Once they were called buskers - the guys wailing Bob Marley tunes on street corners. They are the traditional white-faced mimes that get under your feet while you're trying to shop. Their floppy hats lie on dusty pavements filled with a few coins. Now they are called 'site-specific contemporary dancers'.

Cityscapes were especially designed to take place in several locations in the urban environment. The first performance in the *Cityscapes* series began on February 2 at the Oriental Plaza in Fordsburg, Johannesburg. [Krouse, 2003] It was a Saturday morning the first Saturday of the month and there was shopping mayhem. This leg of Cityscapes was about the different strata of individuals found in a place like the Oriental Plaza: waiters, shoppers, security guards and parents with kids. Dressed in white, with white faces, they danced in unison with little reverence for the space they invaded. This was dance about the moment. The security staff hassled spectators, keeping them behind makeshift barricades. Unwittingly, they had become integral to the power play in this city showcase.

A public space is rich with aesthetics, or non-aesthetics. There are points of tension there quite different to what you get on a clear stage inside a theatre with cushioned seats. This new dance mode is about taking theatre to the people, in places where the public feels comfortable and where they are not alienated by a formal stage performance but where they become an integral part of the performance itself.

Fig 5. Dancer from the *Rhythm Blues* production at the FNB Dance Umbrella, 2003.

Fig 6. Dancers from the *Tales of the Mud Wall* production at the FNB Dance Umbrella, 2003.

Fig 7. Siyanda Duma from The Siwela Sonke Dance Theatre in *Cityscapes.*

Other artists who played a role in The FNB Dance Umbrella were companies like The Agulhas Theatre Works, Tribhangi Dance Theatre Company, an Indian dance company, The Lebohang Dance Project, The Tumbaka Dance Company from Zimbabwe, The Fantastic Flying Fish Dance Company from Durban, The Jazzart Dance Theatre from Cape Town and the Flatfoot Dance Company also from Durban. International companies included The Union Dance Company from England and The Phillipe Saire Dance Company from Switzerland.

The Vuyani Dance Theatre Project is another showcase for all kinds of emerging talent. Gregory Vuyani Maqoma founded the Project in 1999. [Hogg,2003] A few of this choreographer's works have been performed at major festivals in Europe. The work that the company produces is a fusion of African contemporary urban styles, music and culture with European contemporary forms.

This company aims at producing work which questions and challenges society values. The performances deal with various themes, which are of concern to young people. The Project combines in a dynamic and theatrical way the many cultures, backgrounds and tastes that enrich South Africa. The company is made of creators and dancers from diverse cultural backgrounds, hence the emphasis on personal artistic development of individuals.

The FNB Dance Umbrella and The Vuyani Dance Theatre Project are only two of many successful attempts to establish a unique culture of dance in South Africa. It is surely going to take a lot to revive downtown Johannesburg into a cultural hub the money is in Sandton and the high walls people surround their homes with show just how nervous South Africans are about the city. For many years, scepticism and negative misconceptions have stunted the potential of Johannesburg's run-down Newtown area. Newtown still remains a vibrant place with a lot of locked-up potential. With the plans of the Johannesburg Development Agency, the Blue IQ Initiative and the talents of our South African people, this inner-city region can be developed into a hub of creative activity.

Fig 8. Dancers from *Moving Cities* at FNB Dance Umbrella, 2003.

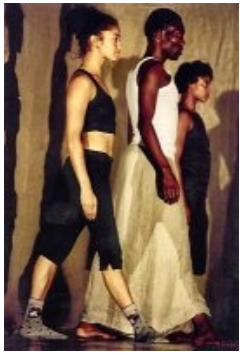


Fig 9. Dancers from *Black Man White Balls* at FNB Dance Umbrella, 2003.

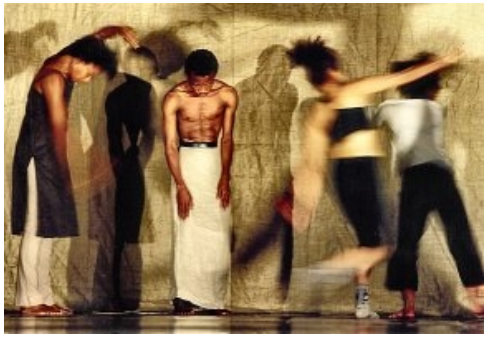


Fig 10. Dancers from *Black Man White Balls* at FNB Dance Umbrella, 2003.

Fig 11. Dancers from *Moving Cities* at FNB Dance Umbrella, 2003.

Visual Form Dynamics:

Form
to give shape, to take shape.

dynamics
the science dealing with matter in movement.
[Alswang and van Rensburg, 1986:323 and 255]

One of the meanings given to the French word *forme* is 'manner of acting or expressing oneself' [de Sausmarez,1976:14] About the dynamics of form Maurice de Sausmarez has written:

'The simplest unit, a spot, not only indicates location but is felt to have within itself potential energies of expansion and contraction which activate the surrounding area. When two spots occur there is a statement of measurement and implied direction and the 'inner' energies create a specific tension between them which directly affects the intervening space.

A line can be thought of as a chain of spots joined together. It indicates position and direction and has within itself a certain energy, the energy to travel along its length and to be intensified at either end, speed is implied and the space around it is activated. In a limited way it is capable of expressing emotions. A thick line is associated with boldness, a straight line with strength and stability, a zigzag with excitement.

Horizontals and verticals operating together introduce the principle of balanced oppositions of tensions. The vertical expresses a force which is of primary significance gravitational pull, the horizontal again contributes a primary sensation a supporting flatness; the two together produce a deeply satisfying resolved feeling, perhaps because they symbolize the human experience of absolute balance, of standing erect on level ground.

Diagonals introduce powerful directional impulses, a dynamism which is the outcome of unresolved tendencies towards vertical and horizontal which are held in balanced suspension.'

Linear systems create opportunities along axis. The use of an axis allows for repetition and the development of rhythms. Movement becomes an important component of the specific linear form that is generated.

Fig 12. A line is a linked series of spots.

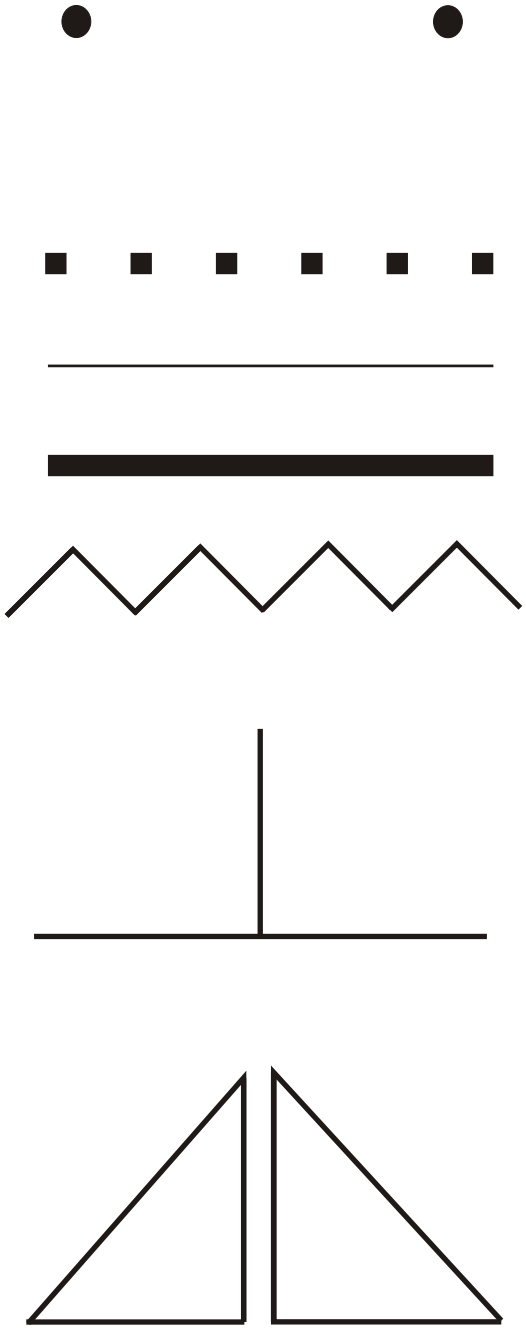


Fig 13. Elements of visual dynamics.

Rhythm:

'When we observe human movement we can notice first of all its regular change. It is a change between waxing and waning of the manifestations of force between tension and release which extends and contracts, lifts and sinks the body, which subjects all movement to a kind of pulsation, to breathing.' [Maletic, 1983:94]

Rhythm is universal in human physical experience, from the conception of the fetus to the final stillness of death. This is an instinctive and unconscious impulse: in the timing of the pulse, breath, peristalsis or the functional action of limbs. It is said that dancers base their measurement of rhythm on their own innate or natural rhythms.

The word rhythm is derived from the Greek *rhuthos* and *rheo* meaning to flow. Rhythm means 'a particular way of flowing'. [Goodridge,1999:42] Rhythm is a patterned energy flow of action. [Barba and Savarese, 1991:211] Theatre, drama, dance, art, ceremony, ritual and architecture are related forms of art, which involve related basic principles of rhythm. Each of these is a totality, which uses a combination of energy, space and dynamics with time elements, in particular environments. These elements do not exist in isolation, but work together to create a whole.

'I have found among my papers a sheet . . . in which I call Architecture frozen music.' [Amis and Rose, 1989:15]

One could not better define the sensation produced by music and rhythm than by saying that it is identical with that evoked by the contemplation of the interplay of architectural forms. Goethe completely understood this when he called architecture petrified music.

Repetition of similar or varying elements in a design tend to set up a visual rhythm, a particular beat, marking the movement of the viewer's eye across a surface. Figures or elements tend to be picked up as pulsations, intervals between them as pauses.

There are basically three kinds of visual rhythm. The first is a kind of staccato rhythm which can visually be seen in a picket fence or heard in a piece of music in which all of the notes are of the same duration, equally spaced and accented. The second type of rhythm is a flowing rhythm where lines are more continuous and curving suggests a more flowing rhythm, with gradual crescendos and decrescendos. A visual example is the contours of a plowed field. The third type of rhythm is a more syncopated rhythm built on variations in the repeated figures and in the intervals between them. An example is the large stepping-stones used in a Japanese garden to conduct people through the sensual experiences of the garden in an informal, erratic rhythm. Normal walking is deliberately interrupted to suggest pauses for contemplation of the surroundings.

'Rhythm will, I believe, soon be proved to be the ultimate building block in not only personality but also communication and health . . . the rhythm of a people may yet prove to be the most binding of all forces that hold human beings together.' [Hall:1983:170]

Rhythm is part of the world we live in every day. It forms an integral part of each aspect of our lives. If we feel as if the forces of division and disintegration threaten any aspect of our world during troubled and disturbing times, perhaps rhythm may be summoned to our aid to nourish integration with its unifying potential.

Fig 14. Performers in *Southern Comfort* at FNB Dance Umbrella, 2003.

Rhythm and movement as a visual representation:

'The concept of rhythm and movement is a conceptual tool. When we use this tool and assorted technology to examine it, we can arrive at another level of process description'. [Byers, 1972:9]

Notation systems are used when certain aspects of rhythm and movement need to be put on paper. There are detailed notational methods designed to record dance movements precisely. Track drawings were used during the seventeenth century in Europe to record the special rhythms of elaborate floor patterns of royal court dances. Feuillets' decorative track system expressed the grace of the dances in an eighteenth century ballroom.

Contemporary choreographers frequently use track notation in the form of free-style drawings to record ideas. Dana Reitz states: '(drawing) is a tool that allows me to see, outside of myself, the direct result of performing a rhythm as I hear it, without trying to copy a completed shape or even to predict one'. [Schwartz, 1982:56] Such a graphical presentation of a rhythm or movement gives an immediate impression to the reader of the scale, shape and span of an event.

Landscape architect Lawrence Holprin explored the possibility of devising a graphic notation system for tracking kinetic environments whether street or stage. His system makes use of frames as in film, and 26 basic symbols to indicate features of the landscape: structures, moving objects and other geometric components. Architects are concerned with the movement of people through their building spaces contained by static elements. Architects like Zaha Hadid and Bernard Tschumi deal more demonstratively with motion.

Many notational systems place the indication of the moving figure parallel to the music, which read from left to right horizontally. Figure 19.

Bayer [Goodridge, 1999:19] suggests rhythm is basically an emotional force with alternation of storm and calm, and concludes what each and every aesthetic object imposes upon us, in appropriate rhythm, is a unique and singular formula for the flow of our energy. Bayer brings dance and pictorial presentation together and states that the understanding of a work of art, whether performance art or architecture, lies in understanding its rhythmic construction. 'We understand a work of art correctly then, as soon as we perceive it correctly in the rhythmic formal sense, and as soon as we feel its true emotional content through this formal perception {Goodridge, 1999:67]

Laban's system comprises of the use of abstract symbols (known as Kinetography or Labanotation).

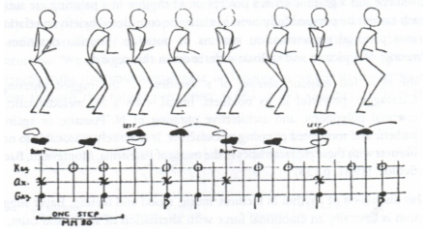


Fig 17. Notation system with musical notation.

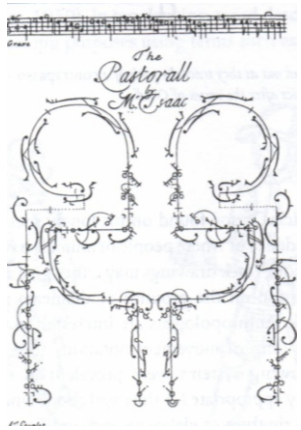


Fig 15. Feuillet's decorative notation system.

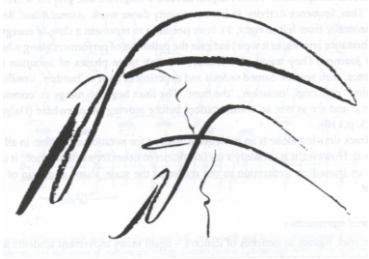


Fig 16. Drawing by choreographer Dana Reitz.

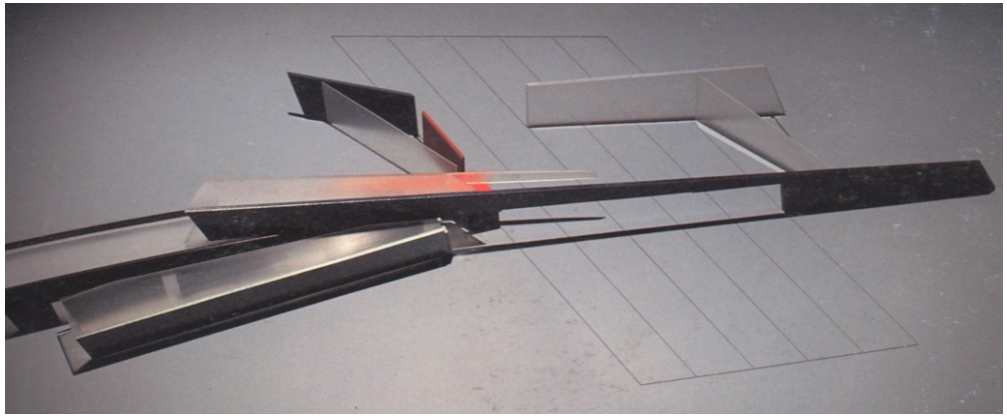


Fig 18. Work by Zaha Hadid.

This system is complicated and utilizes a vertical stave, which is read from from the base, with bar-lines to indicate metrical division of time and symbols to represent different body parts. Other methods of movement notation include the use of abstract signs, boxes, graphs and charts. Valerie Hunt's movement behaviour scoring method includes 'patterns of energy' as well as 'shape rhythm's rhythm in movement with four headings: burst (explosive), sustained (smooth, continuous), undulate (wave) and restrained (irregular), with three degrees in each.'[Goodr]

Kubik devised a frame-by-frame system of movement notation to describe the action of Angolan boys' initiation ceremonies in South Africa [Goodr:1999:98]

The work of Rudolf Laban: time and rhythm in human movement:

Rudolf Laban, the Hungarian-born choreographer, has investigated the significance of movement in the life and dance of our times. Laban made an in depth study of movement phenomena and of factors generating them. Movement therapists, choreographers, dance notation and movement teachers are familiar with the work of Laban.

'Rhythmic movement is the basis of play and art . . . The actor on the stage shows in his rhythmic movements a great variety of efforts which are characteristic for almost all shades of human personality . . . . In watching dancing, our interest is focused upon the visible efforts forming the rhythm expressed by movement. In a similar way we can discern the rhythm in the efforts of any working person . . . . We can gather the meaning of a movement and though it seems difficult to express it in exact words, rhythm conveys something by which we are influenced; we may be excited, depressed or tranquillized.' [Goodridge,1999:129]

Laban gave rhythms names like 'wild or soft' and 'frightening or appeasing'. By naming rhythms we give a general idea of the mood they evoke. The experience of architectural space and form also evokes emotions in people. Many of us feel dwarfed by a giant cathedral, or gigantic like Gulliver among the Lilliputians when confronted with tiny objects that have been greatly scaled down from their normal size.

Laban distinguished four motion factors common to all movement as **'weight', 'time', 'space'** and **'flow'.** [Goodridge,1999:131] All are present to a greater or lesser extend in any movement. These aspects can also be applied to architecture. They are used quantitavely in movement and not in isolation: Weight, as a measure of strength or use of muscular energy. The range of expression is from strong and powerful to delicate or gentle. One element of a building can appear to be solid and heavy, while other elements appear delicate or even weightless. In architecture, we can relate the laws of gravity to weight. We are accustomed to accommodate our actions to the weight of objects and the understanding that they will drop if released. To make a sculpture stand firmly without toppling over or to design a building that will not cave in when walked in these are difficult challenges. A cantilever projection of a building provides a sense of dynamic tension, of one force

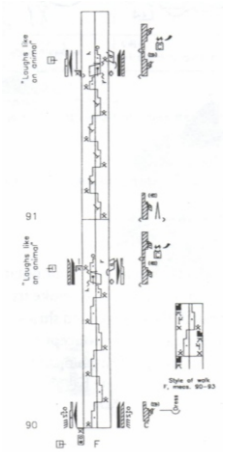


Fig 19. Labanotation.

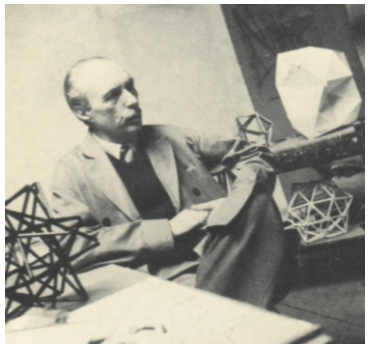


Fig 20. Rudolf Laban.

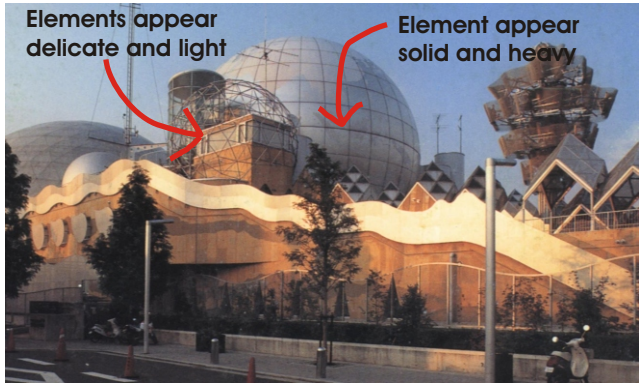
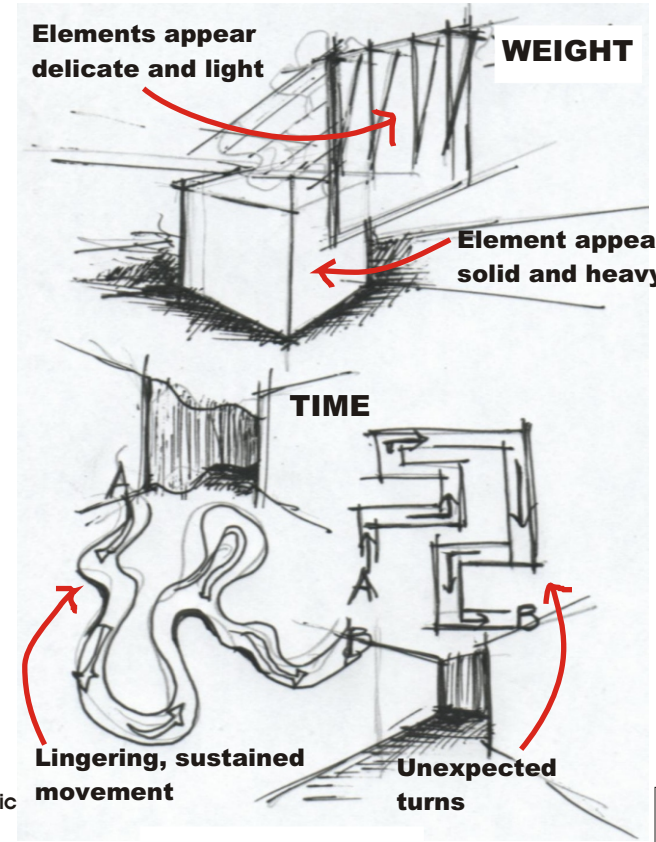


Fig 21. Different weight characteristic in architectural form.



just barely outweighing another in an exciting balancing act.

· Time, as a measure of durational length: extends from the suddenness of an unexpected action to a lingering, sustained movement. The time element is critical to architecture and three-dimensional art. Viewers must want to take enough time to move through a space, experiencing it, or move around a piece of art, investigating it from all sides. Arts involving the continuum of time, like dance, are called temporal arts. [Zelanski and Fisher,1984:251] Dancers change the patterns formed by their bodies and by their relationships to other dancers and to the stage as they move through time and space. We tend to view art or architecture as objects whose value can be repeated in time by repeated viewings. However, the beauty we find in a single moment of shapes changing, like a dance, cannot be captured and exactly repeated like it was originally.

• Space, shown by a degree of angle in gesture or floor pattern: ranges from an extravagant, roundabout pliancy at one extreme to a more directed, economical linear focus. Architectural space can be wide and open or narrow and channeling.

• Flow, as the degree of continuity or controlled pausing: from freely going movement to a held back restraint. Flow can be seen as movement along a line. A straining effect promotes security, whereas one, which arrives somewhere new, tends to promote less restraint. In Japanese calligraphy the first lessons are given as large arm movements in the air. The flowing lines that form words therefore exist not only in calligraphers' minds but also in their bodies, like ballet movements. A flowing quality in

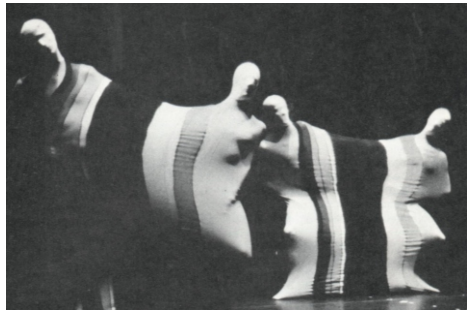


Fig 22. Flow: a degree of continuity.

line does not indicate that the motion used to make it was totally spontaneous. When Jackson Pollock flung paint from a brush onto canvases, he did not do so randomly. He developed control over his arm movements, making possible carefully calculated effects such as exciting colour juxtapositions. To control lines without actually touching them is very difficult.

Laban studied the use of space and he recognized ways in which spatial aspects of movement contribute to rhythm. He defines space-rhythms, time-rhythms and weight-rhythms. In reality, these three forms are always united.

Space-rhythms arise from the related use of directions, which result in spatial forms and shapes. Two aspects are relevant: the one in which there is successive development of changing directions and the other where shapes are produced through simultaneous actions of different parts of the body.

Fig 23. Restricted space.

Fig 24. Wide, open space.

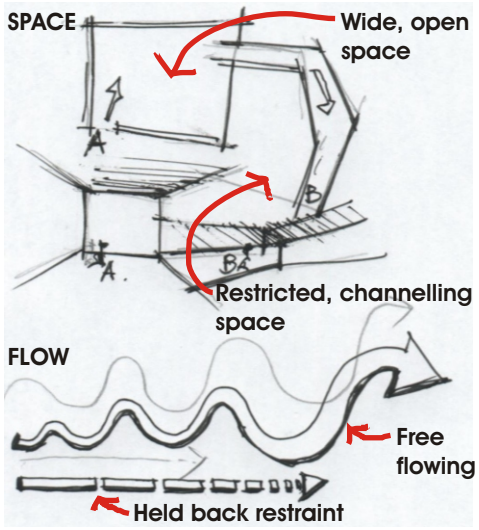


Fig 25. Motion factors: Space and Flow.

Fig 26. Jackson Pollock's flowing movements.

Laban's exploration of geometric forms in relation to movement in space is well recorded. Movements in dimensional directions (directly up-down or side-to-side) promote stability. Movements in diagonal directions promote mobility. Laban drew attention to the 'calming' nature of movements in one plane, and the 'rousing' effect of those using three-dimensional pathways. Contracting and opening, tensing and releasing, are examples of key movement-rhythm activities. These activities can be observed in the stylized forms of fencing and swordplay, with their contrasting gestural patterns of curves and thrusts.

Movement may be the same, in unison, or they may be complementary, contrasting or in counter rhythm. A striking example of group unison action is the popular Irish *Riverdance* shows. Spatial rhythm is generated in this example from the contrast between the erect, vertical body carriage and up-down emphasis of steps, and the fast, even, horizontal lines of the dancers traveling across and around the stage. A path of movement is visible here. The angle employed at a change of direction 'colours' the rhythm. The use of wide angles or curves brings forth a different rhythmic pattern from the use of narrow angles. The more rounded curves have a calming effect while the sharp, narrow angles (like a zigzag pattern) has a dynamic, energized effect.

Accents occur in a number of ways both in a performer's body itself and in the use the performer makes of the performance space. A gesture, step, turn, jump or change in dynamics may be accented, 'standing out' from what it follows or precedes. Change of direction, entrance to or exit from a space, contact with other performers or the use of the performance environment (like moving up a flight of stairs) may be accented.

Accents occurring frequently, very close together, can be referred to as 'dense'. If accents occur spread apart, they can be seen as 'sparse'. The first situation contributes to a mood of excitement, urgency or panic. Accents placed erratically can produce a disturbing, strange or even frightening effect.

In the use of pausing or stopping, movement may be a form of accentuation and may alert attention, especially if it happens unexpectedly. This is illustrated in a description of a Balinese dance:

'Rhythms are taut and syncopated throughout, and filled with sudden breaks and unexpected accents. . . Dance movement is not conceived in a single broad, legato line, but continually broken by fractional pauses that coincide with the breaks in the music: on these the dancers come to a sudden stop, and the eyes of the spectators focus momentarily on a motionless sharply defined pose.' [Goodridge, 1999:151]

A pause may draw attention to what follows. Significance of pauses may be linked to the Japanese concept of the spaces between the lines of design being as important as the lines themselves or even more important than the lines: lines as containers for spaces, pauses as containers for movement.

Repetition is a common organizing element in movement patterns. Repetition can bring a sense of security and a form of coherence to the whole.

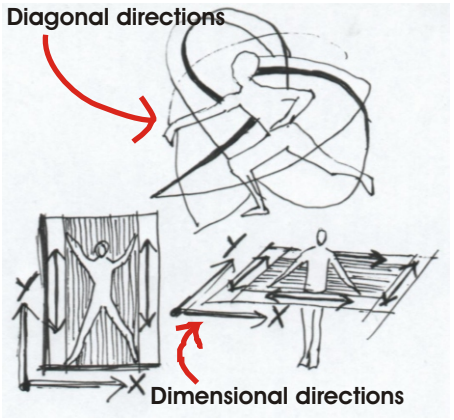


Fig 27. Movement in space.

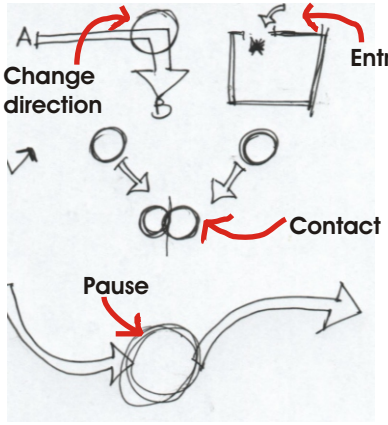


Fig 28. Accents created by pauses, change in direction and entrance.

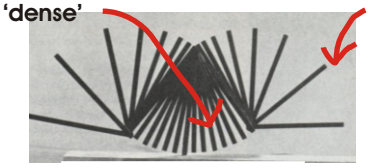


Fig 29. Placements of accents.

Performance environment:

Movement and rhythm develops from a mix of spatio-dynamic characteristics. The performance environment can be considered as the physical circumstances in which the performance takes place. This environment frames or may limits, extend or complicate the possibilities of rhythm.

The size of a performance space and how this area is used in relation to spatial factors of rhythm is important. Configuration of shape, levels and height of the stage area influences rhythm. New concepts of rhythm were brought to the London stage in the 1973 production of Lorca's *Yerma* presented by the Nuria Espert Company, in which all the action took place on a trampoline stretched in different ways during the production. [Goodridge,1999:167] The height of the performance space above the floor is significant in relation to spatial rhythm.

The texture of the surface of the performance area can affect the use of rhythm and movement. If an event is transferred from an outside location on rough ground to an indoor location with a highly polished floor, the conditions and limits for the use of movement and rhythm have altered. The Dance company Pilobolus, visiting Sadler's Wells Theatre, London, 1985, used a plastic stage-cloth flooded with water, on which they skidded and slid, carrying weight on various parts of their bodies. [Goodridge, 1999:169] Obviously the surface influenced their use of rhythm. Contemporary dance choreographers like Jackie Lansley and Rosemary Butcher both made use of outdoor locations with surface-textures varying from sand or rough stones on a beach, to hard cement. Peter Brook's production of *The Mahabarahta* was played on a beach of sand with a canal of water and real fires lit. [Goodridge, 1999:169]

Connections between performers and spectators and the location of entrances and exits affect spatial rhythm. The spatial disposition of spectators is primarily determined by the shape of the performance area. The degree to which spectators may participate in or contribute to the rhythm of a performance may be affected by aspects like their proximity to the performers and ease of access they may or may not have to the performance area. In live theatre there has been strong reaction against the separation of the play from the audience, which is characteristic of the typical proscenium theatre of the past. A performer to audience relationship is important: the auditorium and the acting area need to be brought into the same architectural space. There needs to be as close as possible a relation between the action of the performance and the spectators watching it. The term 'open stage' is used for the arrangement in which performance and audience are contained within the same space. There are basically two types of 'open stage' forms: the round stage and the transverse stage. [Corry, 1980:18] In the case of the round stage, the audience surrounds the performance area on all sides. Entrances are made through the audience or from under the stage. There is no scenic background to the acting area and no problem of horizontal sight lines. A variation of this form is the transverse stage where most of the audience sits on two opposite sides and made face one another across the stage. Advantages include a greater emphasis on three-dimensional qualities of the live performance, especially in dance performances. The 'open stage' is more a product of safety regulations. There is less scenery and the cause for fire hazards are less.

The setting, lighting and other visual effects contribute to the overall performance rhythm. The visual component at rave events, including lighting and other effects, such as dry ice shot through with laser beams, makes a considerable contribution to the rhythm. The rhythm of the lighting is specifically designed to complement and synchronize with the rhythm of the music.

The effect of wind on a performance if noticeable, whether it is man-made wind or natural wind as a result of an outdoor performance. This effect can be seen in rhythms of the dancers, in their costumes, in plumes or in elements of décor like flags.

Physical, social and cultural context: a macro-analysis.

Architecture exists in relation to two sets of conditions. Firstly buildings must respond to fundamental issues such as the need for shelter and for ideas to be symbolized. Secondly building must relate to a region, to a specific location, to topography, to the path of the sun, to variations of temperature, to the movement of people.

There are three key factors which affect architecture. [Baker, 1996: xviii] Buildings must respond to site conditions, functional requirements and to the culture in which they find themselves. To understand buildings, all three of these factors must be taken into account.

In any analysis of architecture one must consider the various factors as forces. In the case of topography these forces are clearly apparent: a road is a force, trees are a force, the climate is a force. Other aspects that consist of forces are neighbouring features, views, gradients, direction of sun angles, prevailing winds, seasonal variations, noise, atmospheric pollution and round-the-clock activities.

Taking the functional requirements into account, the organisation of a building can also be considered in terms of its force characteristics. Form can be either linear or centroidal, static or dynamic. A tower may be thought of as a dynamic vertical force and a bridge as a static horizontal force. Christian Norberg-Schulz explains the act of architecture as being 'to understand the vocation of the place'. He emphasizes the need 'to concretise the genius loci. . . by means of buildings which gather the properties of the place and bring them close to man.' [Norberg-Schulz, 1980:23] He places emphasis on features of topography and landscape which give a special character to places and shows how architecture can respond by creating a meaningful environment. Throughout his book *Genius Loci, Towards a Phenomenology of Architecture,* he constantly refers to man-made and natural forces. [Norberg-Schulz, 1980:23] In his study of the city of Prague he identifies the characteristics of the region, showing how the city became a nodal point formed by physical elements like roads and rivers.

The third factor which influences architecture is culture. Norberg-Shulz describes the relationship between the individual and society and how cultural integration depends on the presence of symbol-systems. 'From birth we try to orientate ourselves in the environment and establish a certain order. A common order is called culture. The development of culture is based on information and education and therefore depends on the existence of common symbol-systems. The culture integrates the single personality into an ordered world based on meaningful interactions.'

[Norberg-Schulz, 1969:220]

'But art, however one defines it, must still mirror, favourably or with hostility, the development of the society to which it belongs. Inevitably, contemporary art, too, reflects the complex and diverse social, political and ethical state of our civilization.' [Hauptfleisch,1997:1]
The metaphor of the mirror is a powerful way of depicting the symbiotic relationship between a society and its performing arts. The arts of a specific community may be seen as a something like a barometer with which to measure the intellectual and emotional, even political, climate of that community. Performance culture has, and still does, engage with the political sphere at a number of levels, especially in South Africa. The performing arts system in any given period and given context may be said to reflect that context, may be able to influence or change that specific context.

Johannesburg as a global mega-city:

'The global city is not a place, but a process. A process by which centres of production and consumption of advanced services, and their ancillary local societies, are connected in a global network, while simultaneously down playing the linkages with their hinterlands, on the basis of information flows' [Castells, 1996:417]

The information age is introducing a new urban form: trans-cultural information cities or 'mega-cities'. The UN adopts a definition of a population of 8 million or more in size of the city [Rakodi, 1997:102]. Size only does not serve as an adequate indication for economic development and urban well being. Some successful world cities have far smaller populations than 8 million. Africa has two mega-cities: Greater Cairo and the Pretoria-Witwatersrand-Vereeniging metropolitan region centered around Johannesburg.

Globalization is generally regarded as a positive stimulus to the development of cities. Global forces interact with local circumstances to produce unique social, economic, political and spatial results at national, regional and city levels. Adoption may lead to adaptation and innovation, to different forms of diversity rather than to global homogenization [Rakodi, 1997:77]

South Africa was isolated from the rest of the world because of the country's apartheid policy. People wouldn't recognize the city of Johannesburg if it weren't for the city's association with gold, Soweto and periodic bouts of violence. If a person who has never been to Johannesburg were transported to the lobby of a five-star hotel in the CBD and thereafter to one of the suburban shopping malls, and asked to identify the city, they would certainly recognize the city as some European or American city. Johannesburg's concrete and glass structures, the variety of branded foods, clothes, music, as well as consumer durables are indistinguishable from those in other mega cities. The skyline of the CBD from a distance, with tall buildings reaching up to compete with the 50-storey Carlton Centre, might well remind them of an image of Dallas. If, however, this person might see the south-western side of the city then he would immediately notice the vast contrast between the townscape they just saw and the sprawling residential townships occupied by Black people. Then only will they recognize the adjacent city to be Johannesburg.

We cannot always make the assumption that South African cities are increasingly similar to other world cities, simply because of the existence of global material culture or the physical appearance of a CBD. Although Coke and McDonald's are everyday commodities from New York to Cairo, and are having major impacts on our lives, we cannot assume that our social and cultural society develops in a linear sense towards a universal word culture.

The largest cities 'serve simultaneously as national and regional engines of economic growth, centers of technology and cultural creativity, homes of the poor and deprived, and the sites and sources of environmental pollution' [Fuchs, 1994:2]

World cities are a cause of problems involving aspects of sustainable development of the urban form. Cities are seen as the major cause of environmental degradation and resource depletion, casting an ecological footprint across the globe. [Girardet, 1996] Cities are seen as congested, polluted, with poor housing, collapsing infrastructure, crime and poverty.

Cities may have problems, but they are not necessarily a problem in themselves. As Mitlin and Satterthwaite [1996:50] observe, it is the 'failure of effective governance within cities that explains the poor environmental performance of so many cities rather than an inherent characteristic of cities in general'. Despite many problems, even the densest, fastest growing city in a developing country has positive benefits for those living there. They can provide 'enhanced opportunity for millions of people', and 'refuges from a stifling, restrictive rural life' that may no longer be economically sustainable [Seabrook, 1996:5]

Our understanding of the dynamics of these cities and the urban systems of which they form part, and our capacity to manage them effectively, are limited, especially in the African context. We need to examine the growth of these mega-cities and the economic, social and environmental consequences.

Fig 30. The City of Johannesburg.

Johannesburg: the past:

To fully understand the functioning and shortcomings of Johannesburg as a mega-city, one has to know the influences of the past that shaped our cultural, social and physical aspects of urban form.

Johannesburg was first established when geological events created the Witwatersrand Basin when, in 1886, gold was discovered. [McCarthy, 1986]
This discovery ensured that Johannesburg would become a mega-city on the highveld of the Transvaal. Within a mere 40 years Johannesburg developed from an unwanted south-sloping remnant of ground to a powerful financial and commercial city. By the time of its golden jubilee celebrations in 1936, Johannesburg already had a population of 475 000 [Shorten, 1970:365]

The discovery of gold resulted in the development of several towns along the east-west line of the gold-reef. Today we know this area as the industrial region of the Witwatersrand, consisting of Pretoria to the north and Vereeniging to the south. Today Johannesburg lies in the south of the richest province of the 'New South Africa': Gauteng, the Province of Gold. It is estimated that, by the year 2020, Johannesburg will be a region containing an estimated 20 million people. [Rakodi, 1997:156]

The role of the Johannesburg gold industry as producer of earnings and as employer of labour bloomed during World War II when the industry manufactured material for the war. After the war mining jobs diminished and a primary industry phase changed into a secondary phase. Office spaces developed in the Johannesburg CBD. Up to 1970 the location of Johannesburg's tertiary services in the concentration of offices was in the CBD. From the mid-1970's onwards, this pattern changed as office clusters moved to the expanding northern suburbs and neighboring municipalities.
By the 1990's actual mining activity become insignificant in the regional economy of the Johannesburg Metropolitan Area.

Johannesburg is seen as the city of finance, as the Johannesburg Stock Exchange is situated here. Johannesburg CBD contributes 12 % of South Africa's GNP. [Rakodi, 1997:161] The Johannesburg Metropolitan Area consumes 9,097 GWh of electricity per annum, which is 5.8% of the total installed capacity of the rest of Africa. [Eskom,1993]

Apart from the wonders that makes Johannesburg such a vibrant urban place, there is also the less attractive, deprived and disturbing side. There are hundreds of thousands of people living in deprived communities or townships. There are many people living in informal settlements erected in the veld. Johannesburg lies at the center of a region that has stagnated, and that has lost ground during the Apartheid era. Political settlement in South Africa, and the arrival of a government that reflects the majority of the people, has brought the plight of deprived communities to the attention of South Africans.

The process of transformation will depend on the successful reintegration of the previously segregated urban components through the reallocation of resources under what is termed the Reconstruction and Development Programme (RDP). [Rakodi, 1997:162] of the new government. Issues that emerge from the past include the provision of basic municipal services; overcoming the housing problem; promoting the development of commercial infrastructure and improved, affordable public transport systems. The challenge for the future is to meld the disadvantaged and advantaged parts of the metropolitan area into a functional whole, while uplifting the underdeveloped areas but retaining the ability to draw sustainable taxes for the common fiscal base from the more developed areas. [Rakodi, 1997:175]

Fig 31. The Johannesburg Metropolitan.

Land Use Trends:

The trends in land use are as follows:

• The deterioration and decline of the CBD is beginning to stabilise as the Inner City's function within the metropolitan area becomes clearer.
• Residential land use is restructuring and growing to accommodate residents of predominantly lower income levels at higher occupancy rates. An example is the proposed residential component in the Newtown Precinct.
This increase of occupancy rate of residential buildings takes place in the Core of the Inner City, as well as in residential areas to the east.
•There are pockets of mainly formal residential land use in the western, north-eastern and eastern parts of the area showing signs of decay and over crowding. The reason for this is the lack of re-investment and maintenance of residential buildings as well as illegal occupation of buildings and land.
• There is an increasing tendency for land uses to change. This can be seen in office use in vacant buildings, in the Core of the Inner City, changing to residential use. In the industrial areas vacant buildings are being used for shack farming: industrial use is changing to residential. The Newtown Precinct changed from an industrial area to a cultural precinct.

• A strong educational belt runs east-west beyond the region: a number of private schools and colleges have located in the Braamfontein area, two universities (Rand Afrikaans and Witwatersrand), and the Johannesbyrg Technikon.
• The manufacturing industry of the past changed into mostly non-noxious and/or service related industry and commercial activities. There are signs of serious neglect which is aggravated by building and land invasions, and illegal land uses.
• Open land is fragmented and is mainly found along the natural ridges running in an east-west direction.

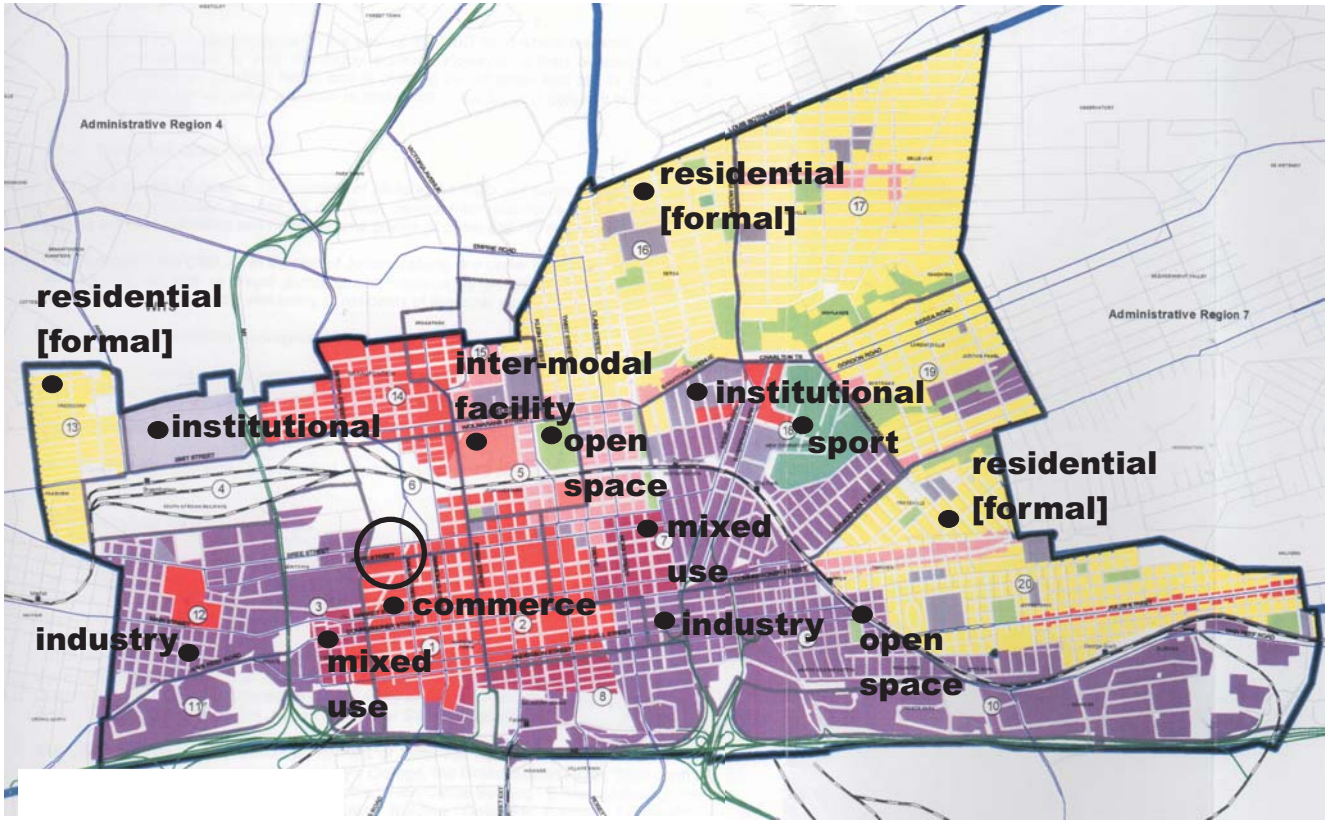


Fig 32. Land use trends.

Environmental Trends:

• Rivers and Streams:
The source of the Jukskei River is to the east of the CBD from where the water flows in a covered concrete canal past the rugby stadium. It then becomes an open, completely fenced in, concrete canal. The canal is polluted by industries that are built within the flood plain. The biggest pollutant is the run off from the city sewers.

• Parks and Open spaces:
There is a serious lack of parks in the CBD and surrounding areas as the existing parks and open spaces do not meet development standards. The open spaces are not maintained and have become places of crime, and illegal squatting and illegal dumping. This results in a poor public environment.

• Areas of Sensitive Ecological Value:
There are no places of real ecological significance. The Observatory Ridge is the most notable natural feature in the area and should be protected from further development.

• Cemeteries:
The Braamfontein Cemetery has reached capacity but can still play a role as a passive open space in the CBD.

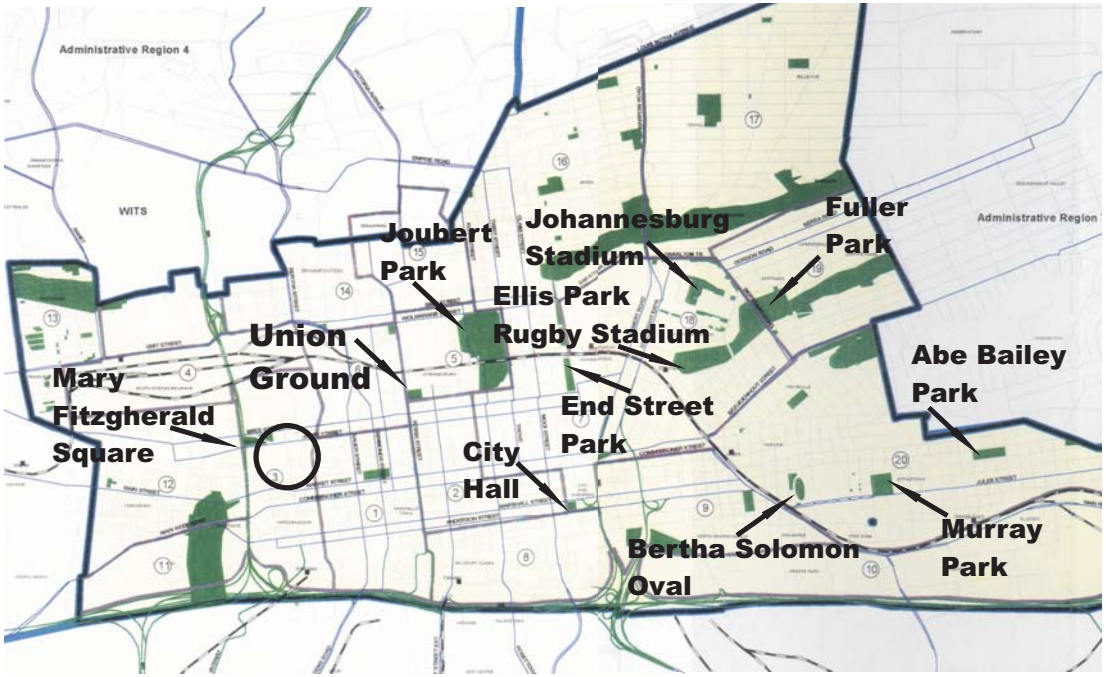


Fig 33. Environmental trends.

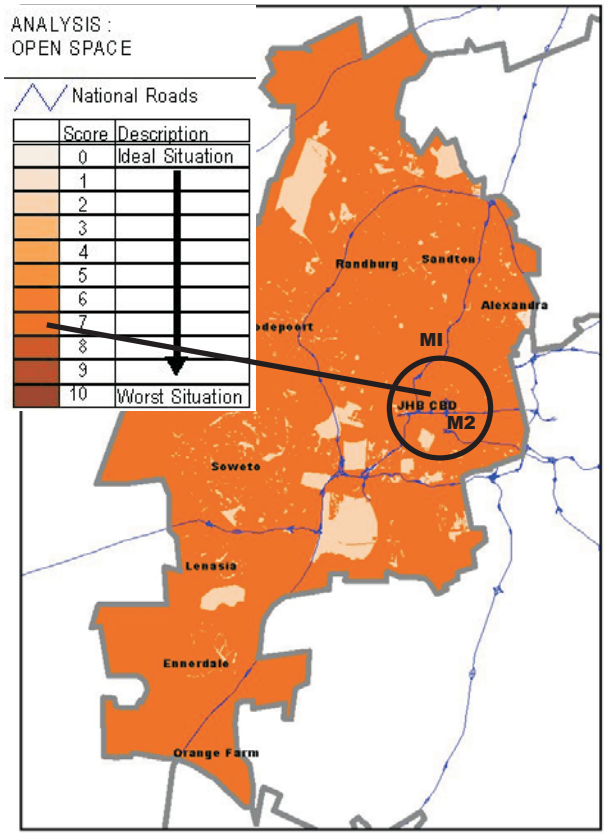


Fig 34. Open space analysis.

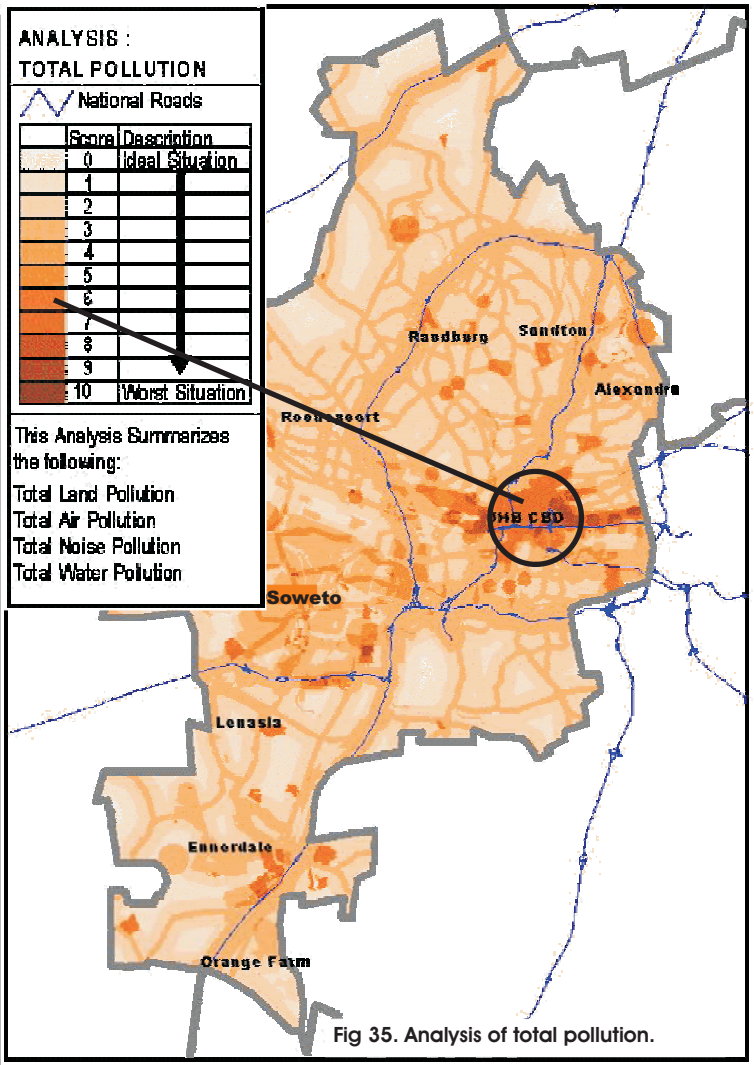


Fig 35. Analysis of total pollution.

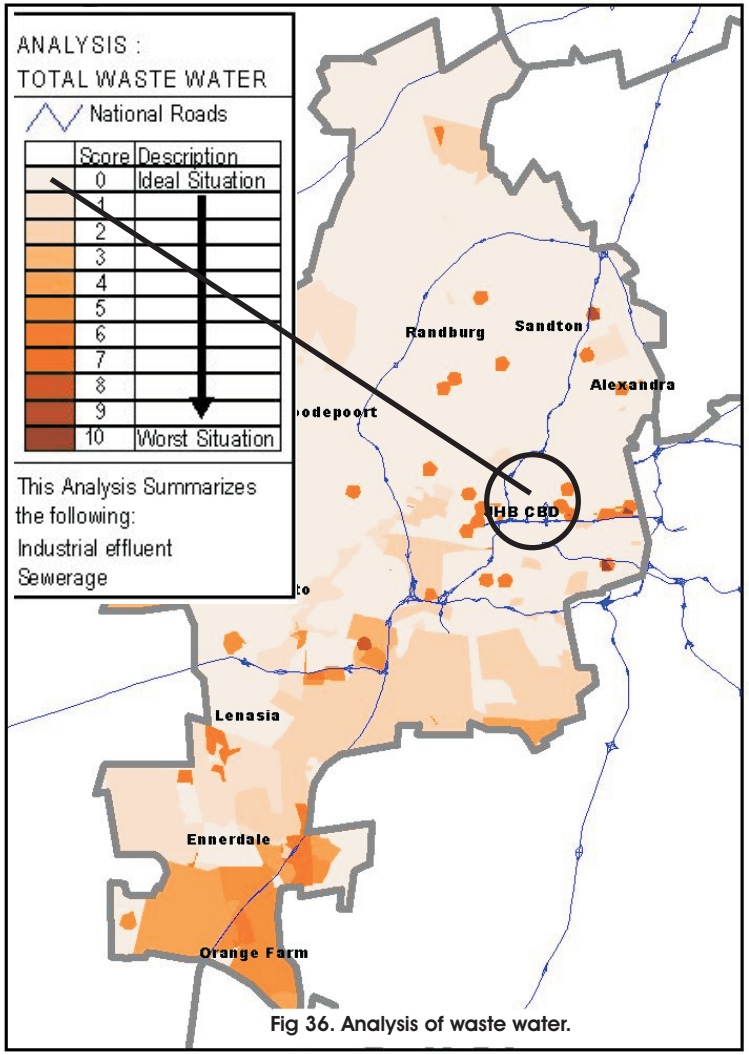


Fig 36. Analysis of waste water.

Fig 37. Waste on the streets of Johannesburg.

Fig 39. Waste strewn around the site.

Pollution:

• Informal settlements:
Poverty and a lack of knowledge in these areas lead to littering, overflow of unmaintained or broken sewerage systems and unmamaged waste management. Dust from gravel or untarred roads causes air pollution. Smoke also causes air pollution. Some settlements around Ennerdale and Lenasia also have inadequate refuse removal services and illegal dumping leads to land pollution. Informal settlements in the central and northern parts of Soweto and Palm Springs west of Orange Farm have the same problems. Illegal settlements in the Johannesburg CBD pose big land pollution problems due to a lack of refuse removal, littering, illegal dumping and overuse/overflow of sewers, especially in the rainy season. The areas with the worst cases of sewerage overflow are Hilbrow, Newtown and Jeppestown. Informal settlements increase the amount of informal traders on the streets due to population growth and high levels of poverty and this aggravate the pollution problem further.

• Mining activity:
The biggest areas of dust/land pollution from mines occurs south of and near to the Johannesburg CBD, and along the whole mining belt that stretches from the south of Denver, southeast of Johannesburg, right through to the south of Roodepoort. Environmental degradation occurs here in the

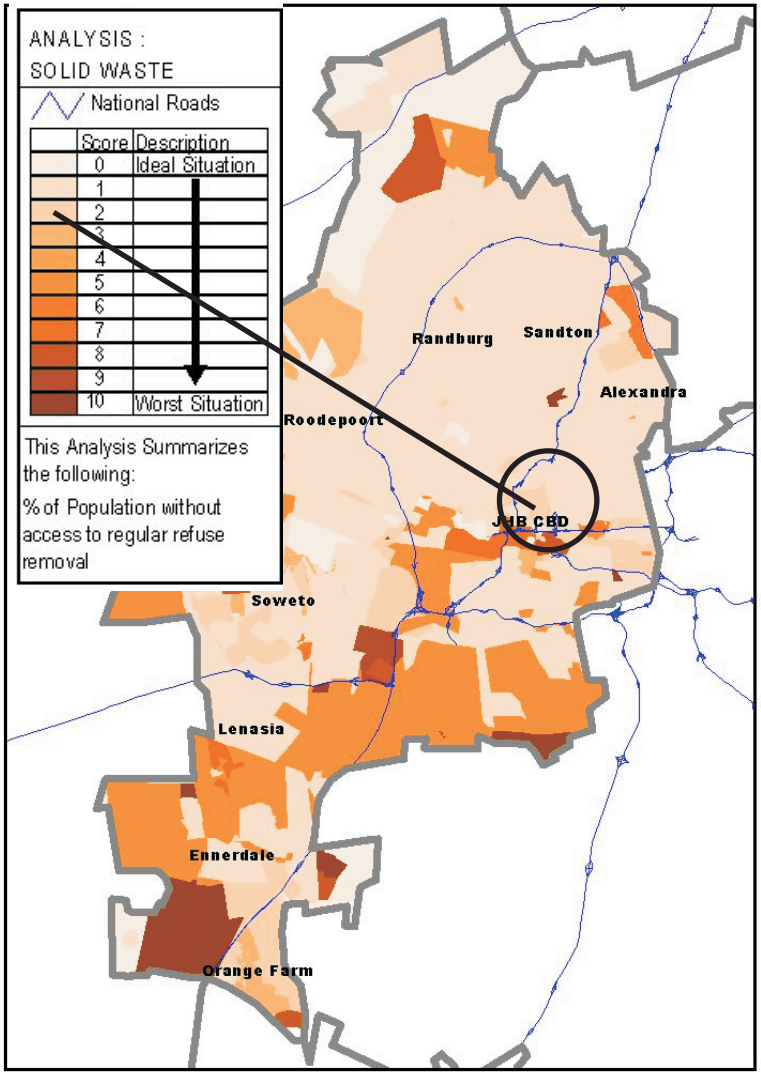


Fig 39. Analysis of solid waste.

form of slimes dams, excavations and exposed mine dumps and stretches of land, where soil erosion and poor soil quality are the major problems. In mining areas a lack of services like running water, refuse removal and sanitation services exist, but are in poor condition. No active mines exist in the far south, north-east and north of Greater Johannesburg, and land pollution due to mining activities is therefore limited to the mining belt running from east to west through the central part of the metropolitan area.

• Waste disposal sites:
Six major landfill sites exist in Greater Johannesburg, and are from the north to the south, Kya-Sands (north of Randburg), Linbro Park (north of Alexandra), Robinson Deep (between Roodepoort and Soweto), Marie Louise (south of the Johannesburg CBD), Goudkoppies (south-east of Soweto), and Ennerdale (west of Ennerdale). All the sites are aesthetically displeasing areas of land pollution, especially where waste is not managed properly. These sites also emit noxious odours, while bad odours were reported from the Goudkoppies Landfill site.

Noise:

Noise generally emanates from the concentration of activities typically associated with an urban environment such as traffic noise and noise associated with industrial and commercial areas.

Noise from an elevated freeway like the M1 which forms the western boundary of Newtown must be taken into consideration but does not have to be considered as a development constraint.

The following figure shows the average noise level readings in dB(A) taken at 40m intervals from the M1:

- The average noise level next to the M1 = 73.0 dB(A)_
- The average noise level 40m east of the M1 = 65.3 dB(A)
-The average noise level in Mary Fitzgerald Square (80m from M1) = 55 dB(A). (Kirchhofer, 1980:6):

Accepted noise levels in dB(A) are:

• Small auditoria, conference, lecture rooms = 45 - 50 dB(A)

• Bedrooms for sleeping and resting = 30 - 40 dB(A) (Krige, 2000:28) (NAD, 2000:18)

The low reading of 55 dB(A) in Mary Fitzgerald Square, 80 away from the M!, suggests that such a lower noise level could be relied on in a space partially protected from noise. The nearest edge of the site is situated 434.3 metre from the M1. The site is also protected by the massive structure of the Turbine Hall to the west of the site, between the site and the M1. There will be no serious problems with noise considering these aspects.

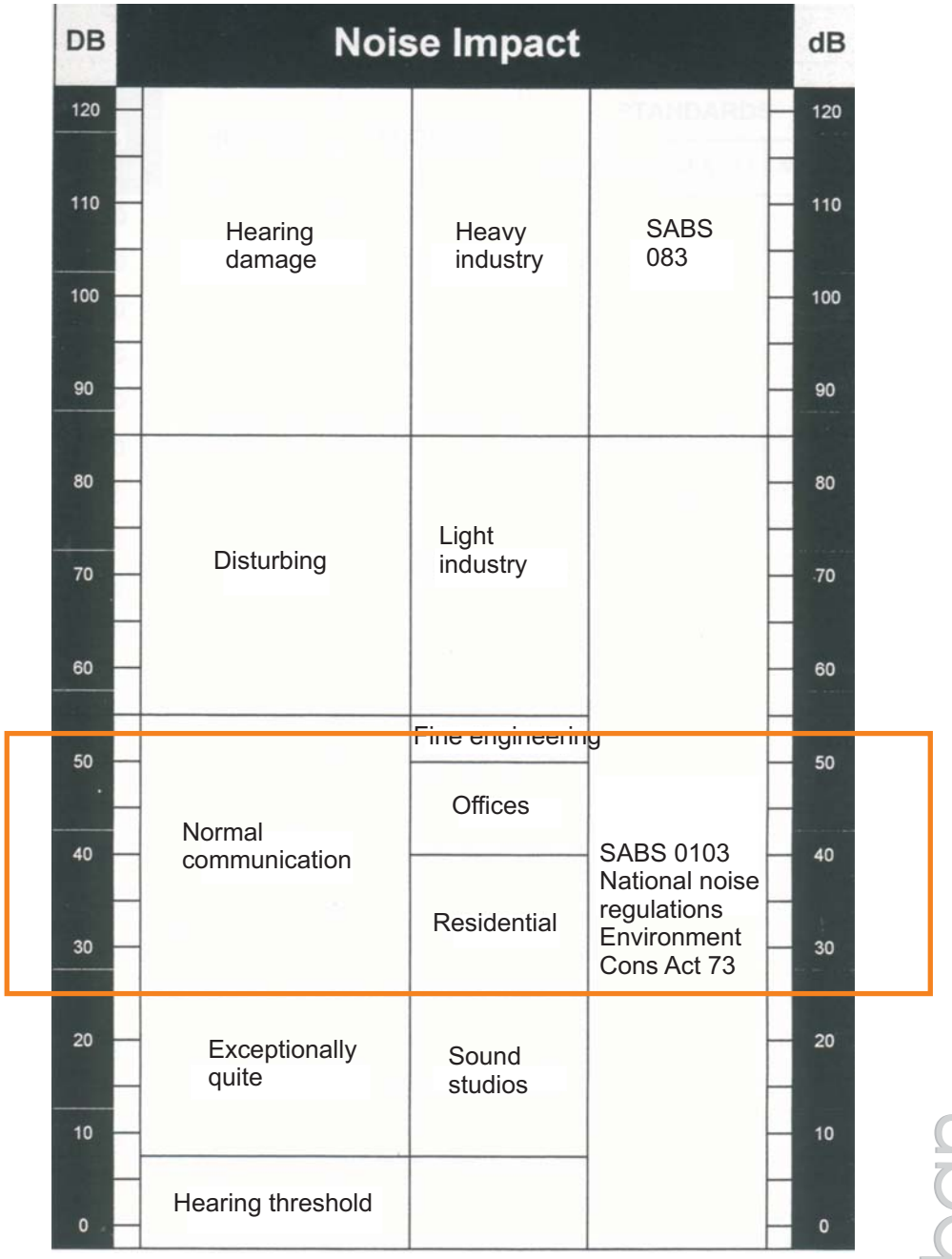


Fig 40. Noise impact according to SABS 0130

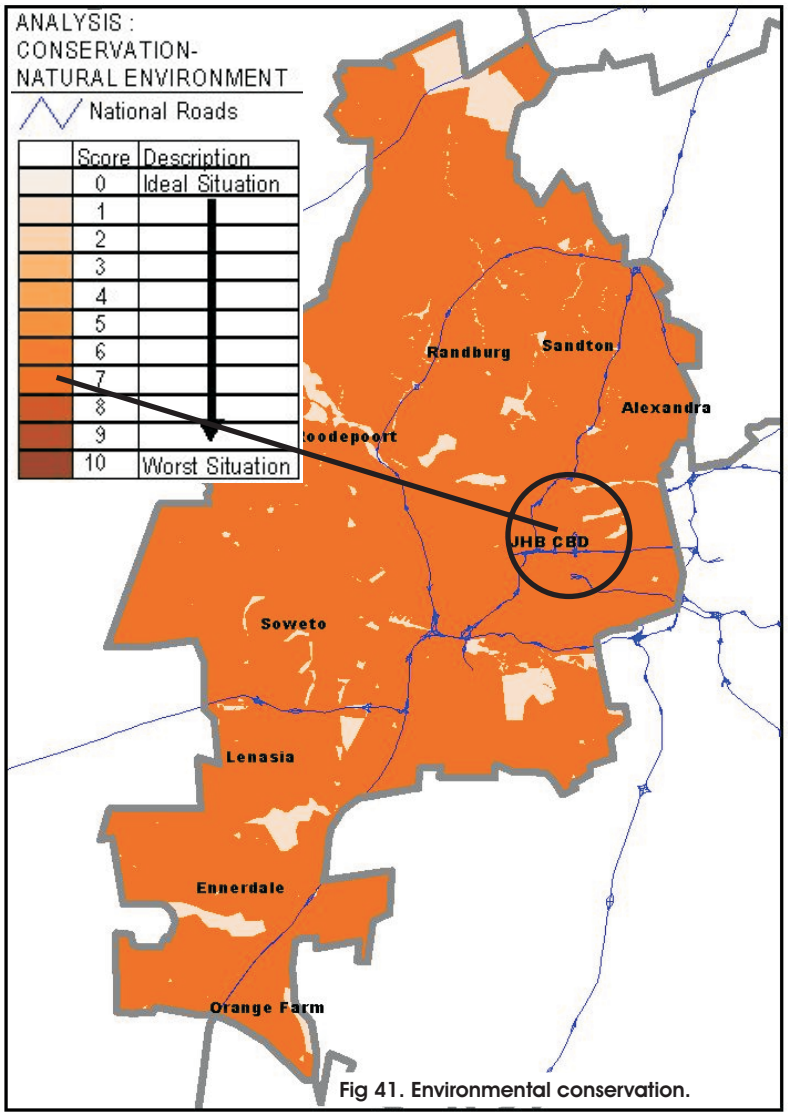


Fig 41. Environmental conservation.

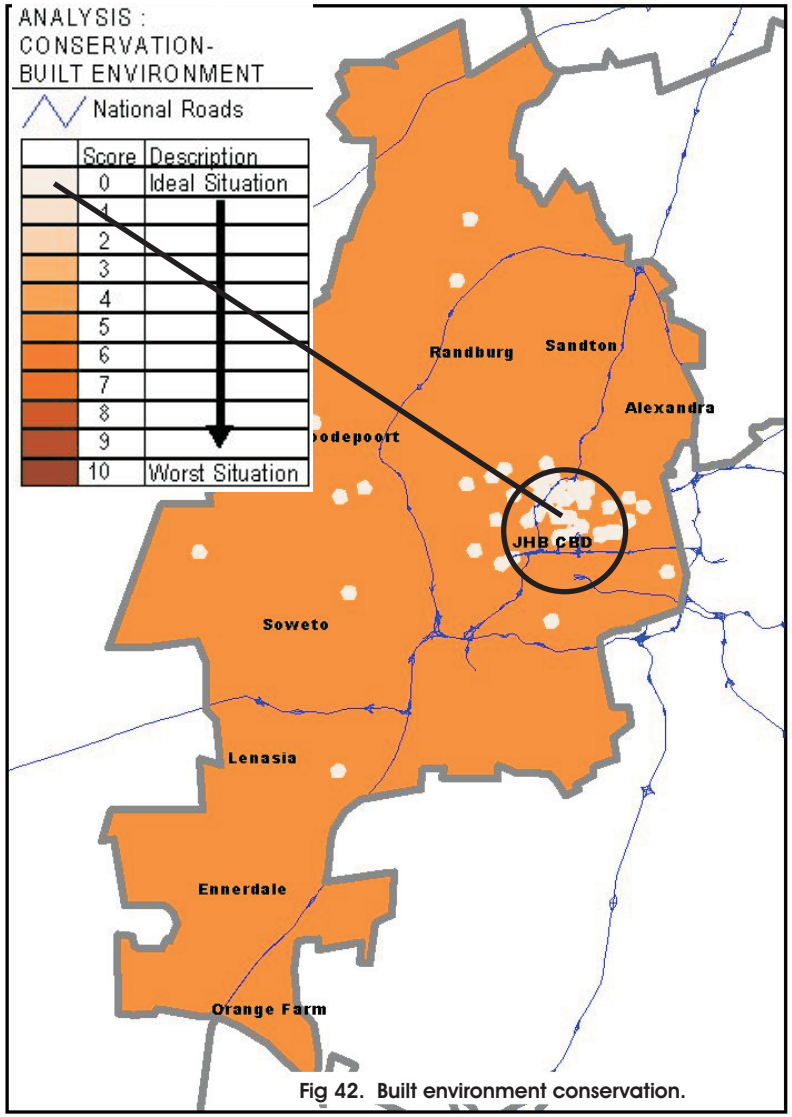


Fig 42. Built environment conservation.

Conservation:

•Sensitive Built Environments:
Numerous buildings, places and objects of historical heritage are found in Johannesburg. Most of the 76 historical buildings in Johannesburg are located in and around the CBD and westwards to Roodepoort.

These include the Stone Age sites in Yeoville and the University of the Witwatersrand. In the CBD there are protected National Monuments such as the Rissik Street Post Office, Old Jeppestown Post Office, Johannesburg Art Gallery in Joubert Park, the Newtown compound, Enoch Santonga Memorial Park and House 34 Becker Street in Yeoville.

The CBD has several historical buildings: Cosmopolitan Hotel in Jeppestown, St Mary's College, the Grand Station Hotel, Saint John's Church and the Union Castle Building.

The houses to the east have historical value. The Simon van der Stel Foundation has done a survey of houses in Bertrams and concluded that the township has historical and architectu-
Ral value and must be protected.The same is true for Art Deco buildings in the Inner City area.

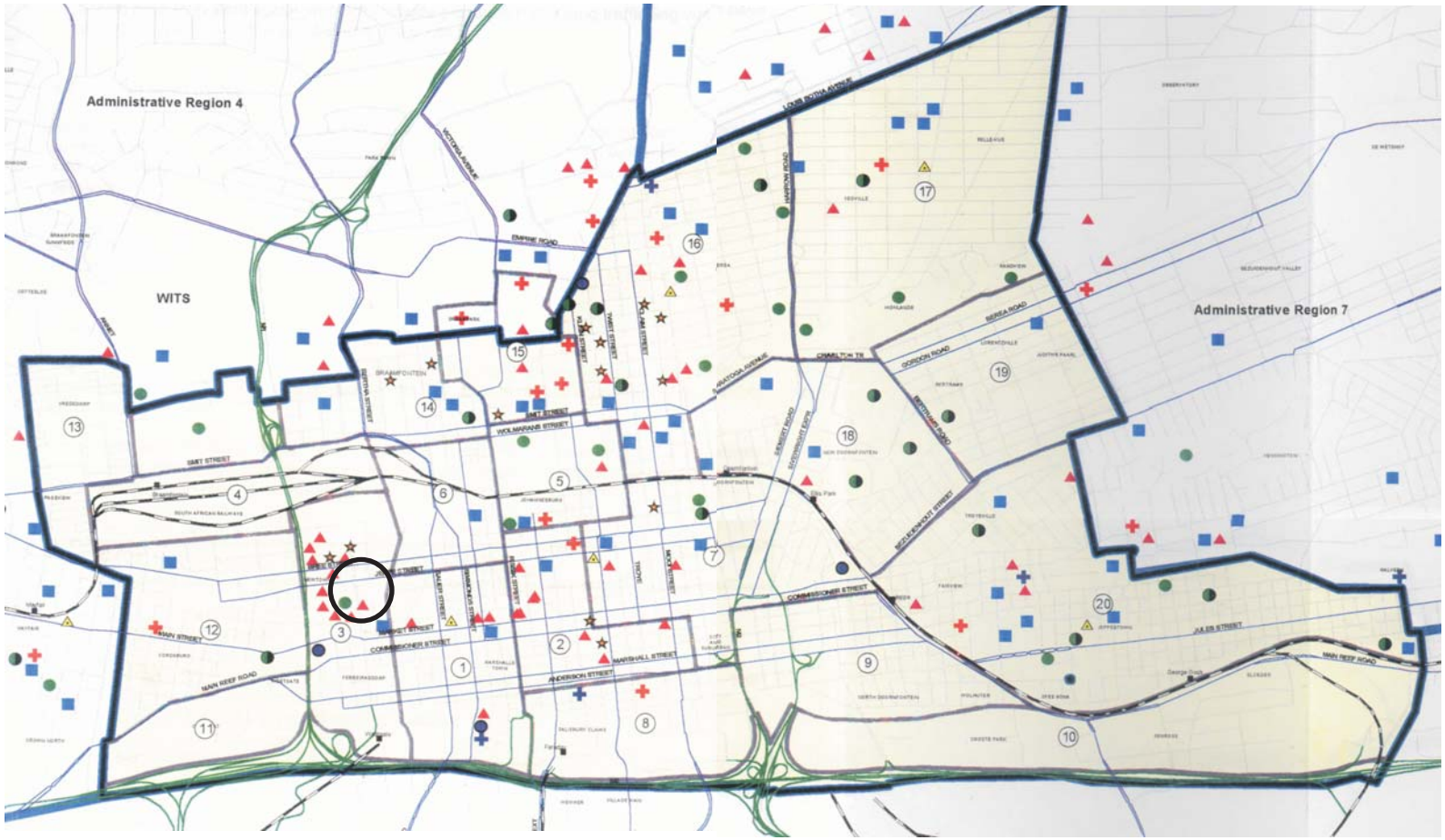


Fig 43. Social services.

Social Services:

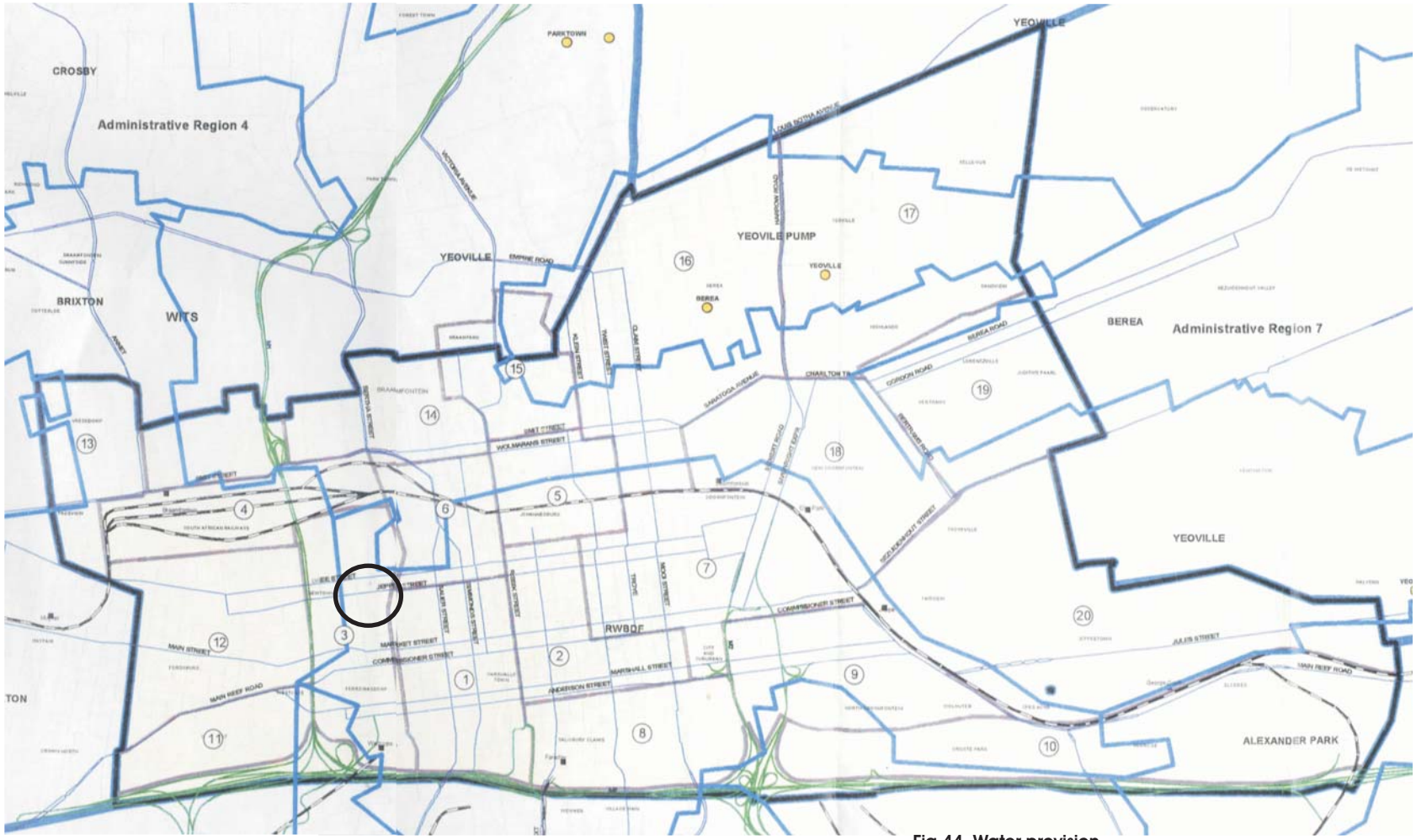
Social services are provided for communities to fulfill their social needs. The provision of such services is linked to economic development programmes. The following aspects form part of social development:

- Education
- Health
- Development welfare services
- Recreation, arts and culture
- Safety and security
- Local economic development

For many households suffering from institutional isolation and social exclusion (such as physical and social distance from schools, clinics, shops and cultural events), the Inner City offers the best opportunities.

The following trends were identified in the region:

- There is an influx of homeless people into the city who needs the public facilities and can not afford private services. It is estimated that there are 4 459 homeless people in the Inner City. (Bambanani Consortium, 201:17)
- As the Inner City population intensifies, the open space requirements increase.
- Open spaces are ill maintained and not suitable for recreational purposes.
- There is lack of safety in parks and public spaces.
- Vandalism of facilities occur.
- There are a variety of public and private schools, as well as two tertiary institutions: RAU and WITS.
- Welfare agencies in the form of six registered shelters for street children exist. Social problems include prostitution and drug trafficking which have a damaging effect on the well being of the youth.



Reservoir zones

Reservoirs

Water:

The city centre area is fully serviced. Reticulation piping in the area was renewed during the early nineties and thus in a good condition. Piping in the Inner City fringe areas requires maintenance and upgrading. Currently there is an intensive water management programme with the Rand Water Board to manage water leakage. The main bulk water pump-station supplying water to the Inner City, the Hector Norris Pump-station, Will require upgrading in the future. The bulk water mains are aligned from the south along Rosettenville/Von Wielligh through to Hilbrow.

Fig 44. Water provision

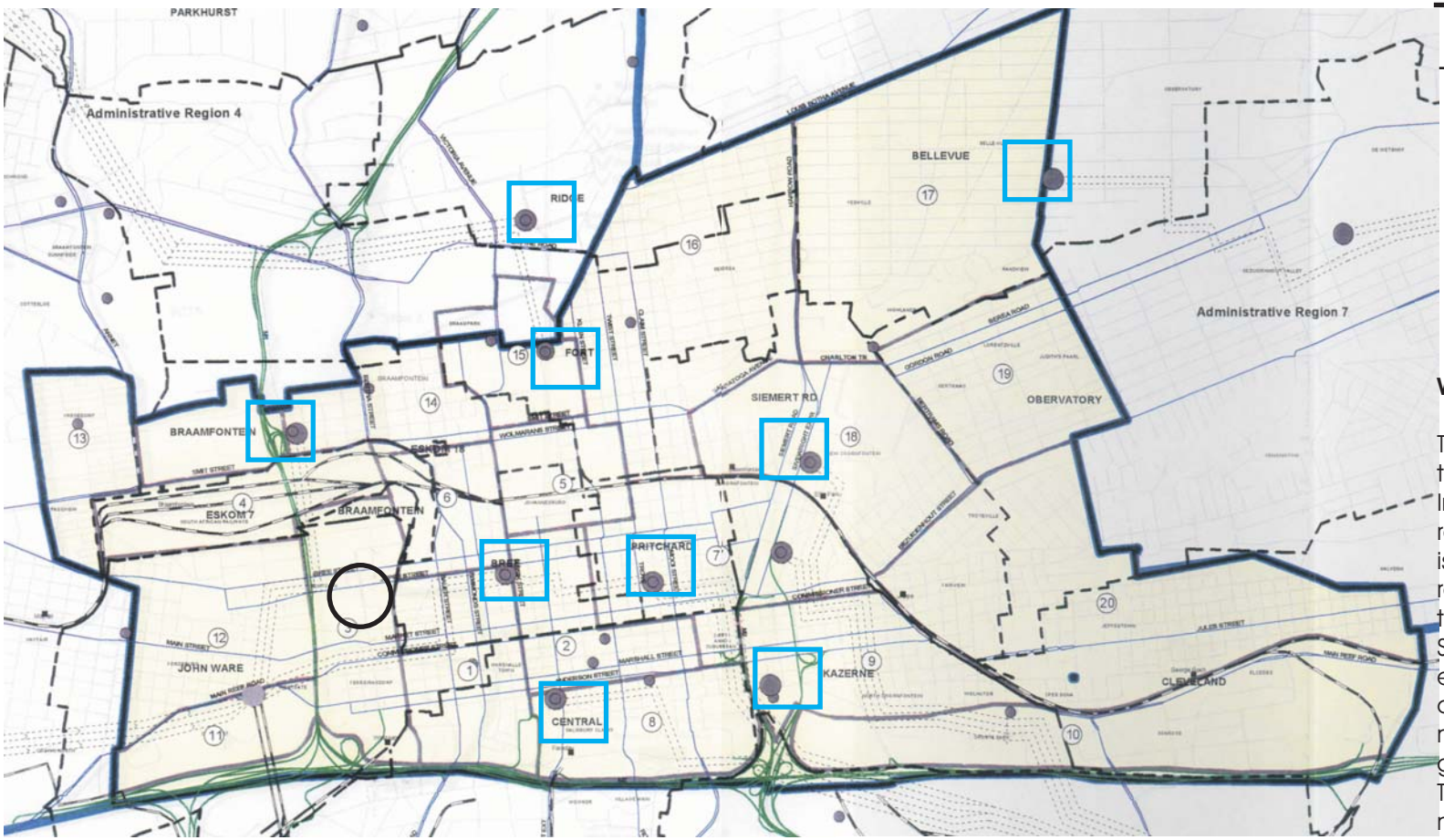
Engineering infrastructure:

Physical infrastructure is needed to support and sustain the urban environment. The provision, operation and maintenance of infrastructure service to meet the community's needs are the responsibility of the local government.

Engineering infrastructure services include:
- Roads
- Stormwater
- Sanitation
- Waste management
- Electricity supply

Roads:

The road network is well developed with a series of east-west and north-sout arterials and the M1, M2 and M3 urban freeways. There is a need for modification and upgrading of the road system to improve movement connectivity, traffic flow, parking facilities and congestion. Links should be provided to improve continuity of roads such as Anderson and Troye. Improvement of the urban freeway system by extending the N17, A3 and M2 west should be considered. The roads are in fair condition but pavements, walkways and pedestrian space need upgrading and maintenance.



Sub Stations Zones (88kV)

Municipality Electricity Network, 8kV and up (distribution)

Municipality Electricity Network, 88kV and up (distribution)

Waste Management:

The extensive litter problem results in the blockage of storm- water inlets. In areas where there is changes to residential or mixed use the services is inadequate and in need of restructuring. The area is served by the Robinson Deep Landfill and Springfield incinerator. The site has an expected lifespan of 20 years with an estimated landfill airspace of 7.8 million cubic metres. There is a garden refuse site at Robinson Deep. The newly created agency, PIKITUP, is now responsible for waste management in the city.

Fig 46. Electricity supply.

Sanitation

The Goudkoppies sub-catchment serves the Johannesburg CBD as well as Melville, Auckland Park, Booysens, City Deep and partly La Rochelle and Turffontein. A few of the small bulk sewers are over capacity, but generally there is a spare capacity so that approximately 200 000 extra people can be accommodated. The Goudkoppies sub-catchment has a spare capacity to accommodate an approximate additional 225 000 persons [Bambanani Consortium, 2001]. The outfall sewer serving the area is the Klipspruit outfal. This area drains from Braamfontein through the CBD in a south-westerly direction to the Goudkoppies catchment near Baragwanath. This catchment is fully developed comprising the CBD in the north; the old mining belt,now largely industrial in the middle; and middle/high income residential to the south.

Electricity

City Power is the main supplier of electricity to the region. There are no backlogs of connections to consumers. The networks are presently fully loaded and, therefore, there is little space capacity available. Low voltage and overloaded feeder cables are a chronic problem and the cause of many complaints by consumers. System reliability is seriously affected by the age of a large portion of the network. Many of the areas were not designed to cater for the rate of development which is currently being experienced. The area is well served with bulk an reticulation infrastructure. Financial restrictions over the past for to five years have resulted in maintenance of the existing networks not being done. This includes the sub-station network as well as the distribution networks.

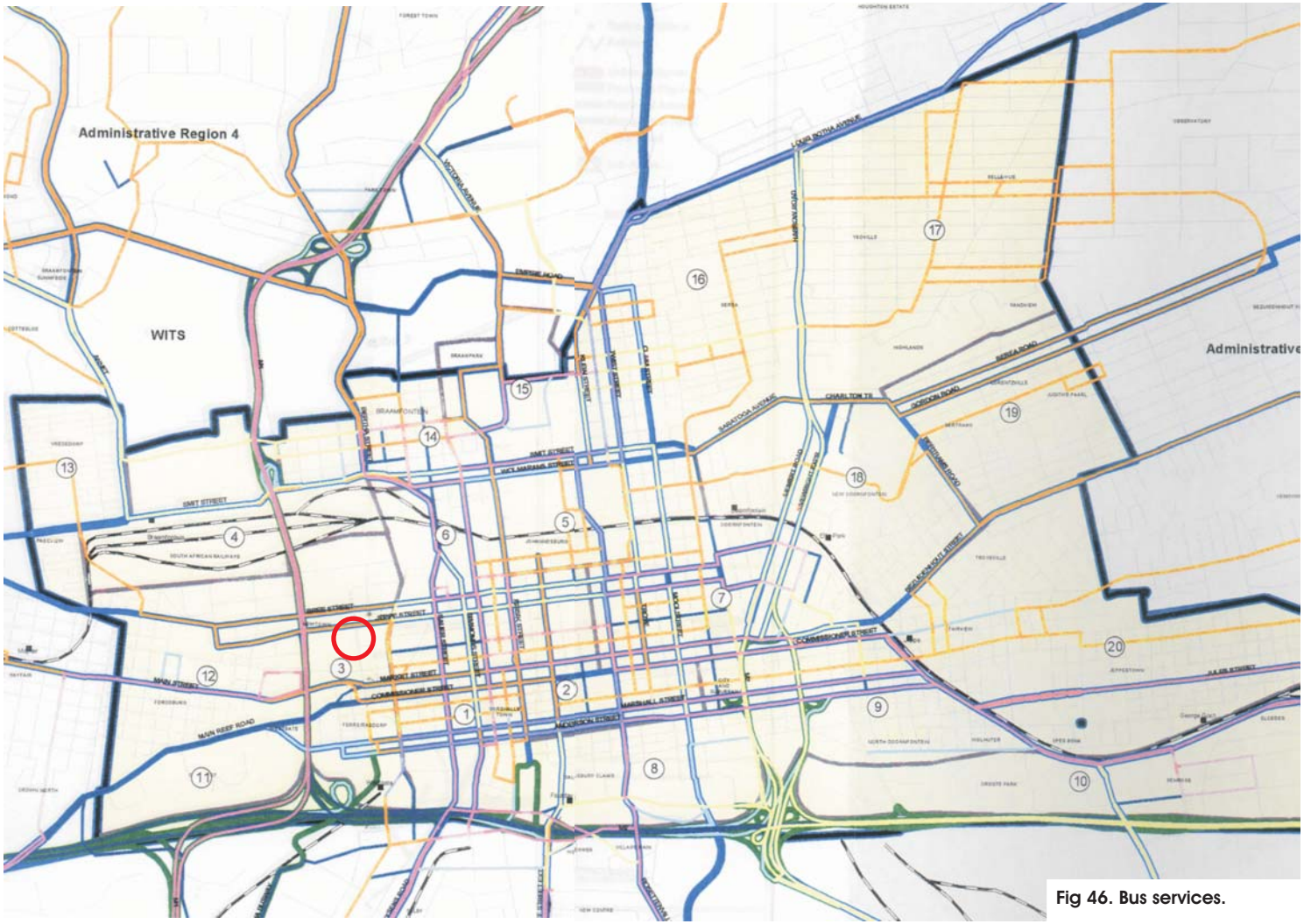


Fig 46. Bus services.

Metro

Germiston

Bus services:

Bus services in the area are provided by Metropolitan Bus Services, Putco Soweto, Putco Commuta, Putco Phapama, Germiston Bus Services, Megabus and Eldo Coaches.

Transport:

• The railway system composes of the east-west line from Braamfontein to Soweto and Vereeniging that passes through the northern section in the west and has 63% line utilization and 75% capacity utilization inbound. The line includes Braamfontein and Park City Stations. [Bambanani Consortium, 2001] The rigidity of the system in terms of the fixed destination points and the lack of an in-city linkage system and the limited capacity of the system to expand existing routes is restrictive.

• The road network consists of the M1 freeway which passes north-south just west of the CBD area; the M2 freeway that passes east-west just south of the region; the north-south M31 which links the M1 to M2 and lies just east of the CBD; and a series of east-west and north-south arterials that operate as one-way pairs in the CBD, like Wolmerans/Smit, Bree/Jeppe, Market/Commisioner and Marshall/Anderson running east-west.

Public transport ranks and termini include:
• Bus termini at the Magistrates Courts, Westgate Station, Bree Street, Sanlam, Stock Exchange, Kay Street in Ruikes Road and Braamfontein.
• Minibus ranking facilities at Joubert Park (Park Central), De Villiers Street, Wanderers Street, Bree Street Terminus, Bree Street at Sauer, Westgate Street, Kruis Street, Delvers Street, Faraday Rank in Stevenson Street, Banket Street, Noord Street and Van Beek Street (near Jeppe Station).

Fig 47. Minibus-taxi services.

Minibus-Taxi Services:

The minibus routes are as pervasive in the area as the bus services. The minibus rotes converge on the CBD as the major interchange centre for their services, and many ranking facilities, such as Metro Mall and Park City, have been and are being provided. Many services and ranks are illegal because there is insufficient enforcement. Metered taxis operate in the CBD area. Most operate illegally.

Conclusion from Macro-analysis:

• Land uses: the existing infrastructure needs to be maintained and further developed to keep up with the demands due to change in land uses, like office and industrial uses to residential use and mixed use. The intensification of land uses in the area that was just industrial use in the past has resulted in an increase in the residential population. There is an increased pressure on the engineering services. The illegal occupation and land invasion in vacated buildings results in crime, vandalism, lack of security and physical degradation of the public environment. Alternative sustainable uses for vacant buildings prior to the taking place of illegal occupation has to be established, like in the case of the re-use of Turbine Hall for a music venue.

• Environment: there has to be made provision for much needed open space in the CBD, whether it is in the form of parks or well-functioning public environments like squares. Existing open spaces and watercourses must be preserved and enhanced where possible. Illegal dumping must be prevented in public spaces. Air and water pollution policies should be drawn up and sewers need to be maintained. Waste management and infrastructure provision must be strengthened to reduce land degradation and pollution.

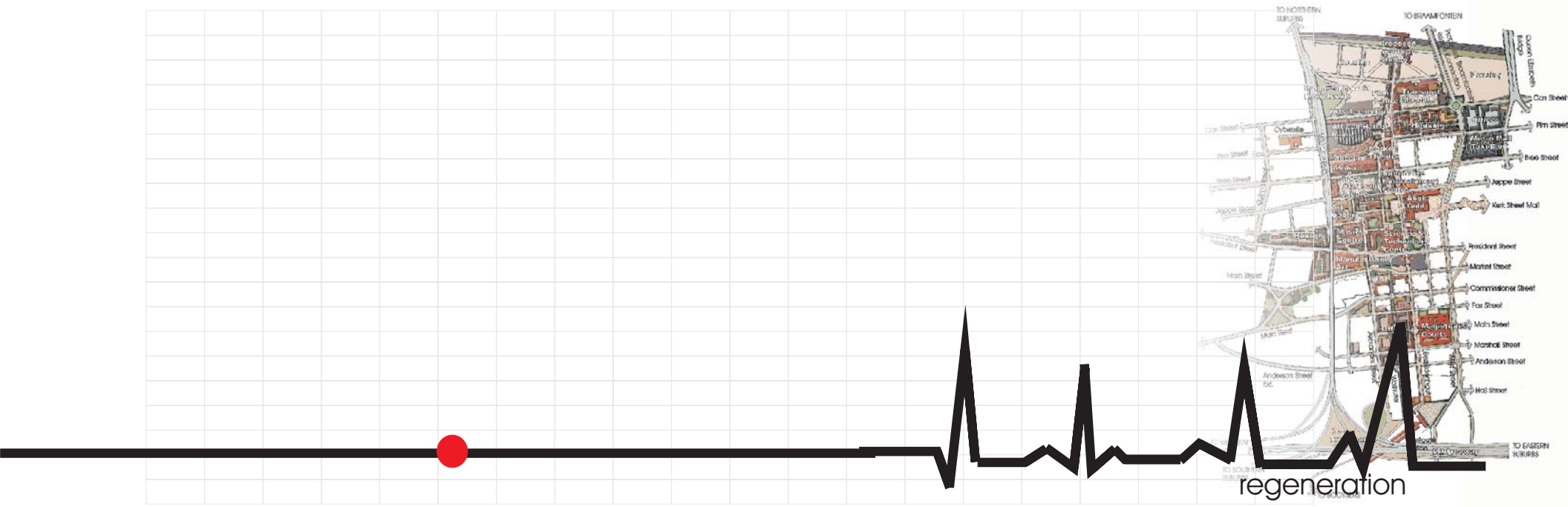
• Pollution: the standard of service provision in the CBD is low in areas where the infrastructure is old. Dilapidated buildings with dysfunctional services within the buildings result in poor living conditions and contributes to a poor public and social environment. These issues need to be addressed. Stormwater management of the Jukskei River needs to be addressed to decrease pollution and provide better living conditions. The lack of financial and manpower resources for the delivery of basic services need attention to reverse environmental degradation.

• Social problems in the CBD include inadequate recreational and cultural facilities and amenities, poor maintenance and inadequate lighting of parks and public environments and high crime rates.

• Engineering infrastructure: all areas within the region require revision of services to cater for changes in land uses and for urban regeneration. Maintenance and refurbishment of the existing infrastructure on a planned basis are needed to ensure environmental and social sustainability. Current initiatives like Parallel Strategy 6 of the Inner City Renewal Strategy has been formulated to improve the situation of services. Services like gas, water, electricity, sewerage and refuse removal, stormwater and telecommunications are included in a Service Infrastructure Policy. [Bambanani Consortium, 2001:22] The renewal process involves the identification of areas under stress through assessment, the establishment of a maintenance and upgrade programme, the identification of funding mechanisms towards maintenance, the establishment of design guides and standards and the monitoring of the strategy at appropriate intervals.

• Transport: the major problem is caused by the changing modal choice of passengers from the south and south-west from higher capacity public transport modes to lower capacity modes; primarily from train and bus to minibus and car. This increase the level of congestion on the roads from the south. The congestion can be displaced to other areas if more direct routes become established between the residential areas to the south and south-west and the jobs to the north of the CBD. There seems to be inadequate linkages and co-ordinated public transport services between the residential areas in the eastern part of the region and the commercial core. A public transport distributer system is currently being planned to integrate the Inner City. The Inner City remains the location with the highest accessibility. This is an opportunity assisting the regeneration of the area.

existing frameworks



University of Pretoria etd - Potgieter, H (2003)

Newtown Urban Design Framework:

The Newtown Urban Design Framework (approved August 1999) a general framework of the Greater Johannesburg Metropolitan Council's intentions regarding the development and regeneration of the Western Sector of the Inner City, as well as the Newtown Cultural Precinct within it.

The Newtown Urban Design Framework outlines the overall physical development of three primary precincts: Northern precinct, Central precinct (including the Newtown Cultural Precinct) and Southern precinct.

The goals for the Newtown Cultural Precincts are:

- Creating a safe and secure environment;
- Improving accessibility;
- Developing Turbine Hall;
- Creating a critical mass and a 24 hour city;
- Establishing a coherent development framework for the area;
- Establishing a focussed special purpose vehicle to drive the development and land release process.

Fig 49. The Newtown Urban Design Framework: site location.

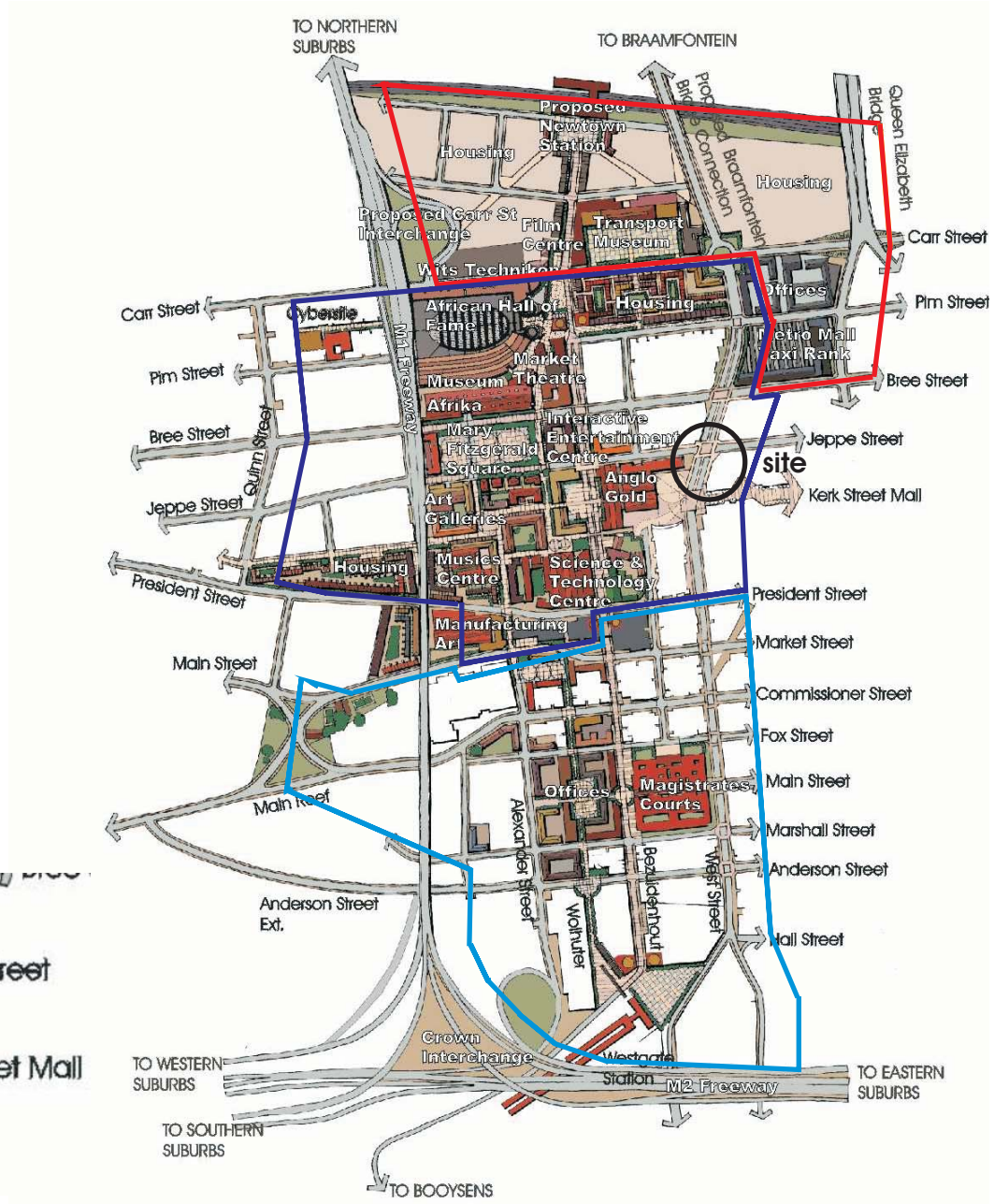


Fig 48. The Newtown Urban Design Framework.

The Newtown Cultural Precinct Urban Design Plan:

The Newtown Cultural Precinct Plan is the more detailed elaboration of the design principles and policies in the approved Newtown Urban Design Framework (August 1999). The plan focusses on individual
Site Development Plans and final building approval: the "Package of Plans" approach. This approach includes the development of parcels of land over a period within a broader urban context to accommodate flexibility.

The Potential Site Development Plan Study Area:

The study area is focussed on the cultural core and adjacent areas, bounded by Quinn Street in the west, President Street in the South, West Street in the east and the railway lines in the north. Figure xx.

The Precinct Plan was structured in three interdependent areas: Core Cultural Sub-zone, Northern Sub-zone and Western Sub-zone. Figure xx

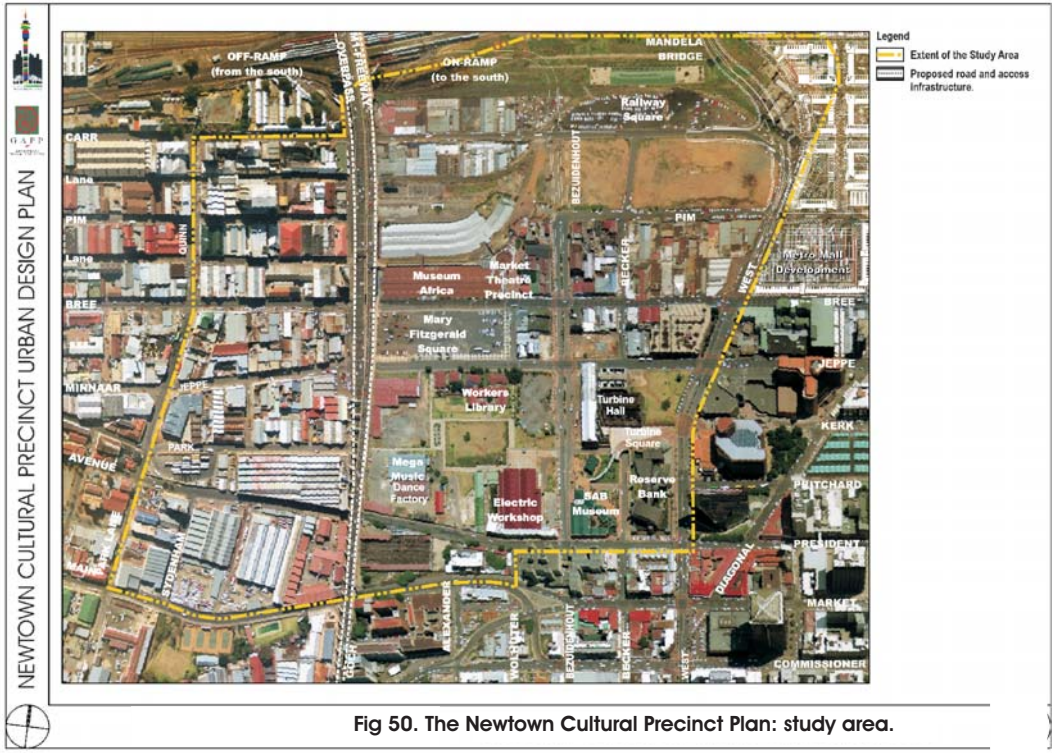


Fig 50. The Newtown Cultural Precinct Plan: study area.

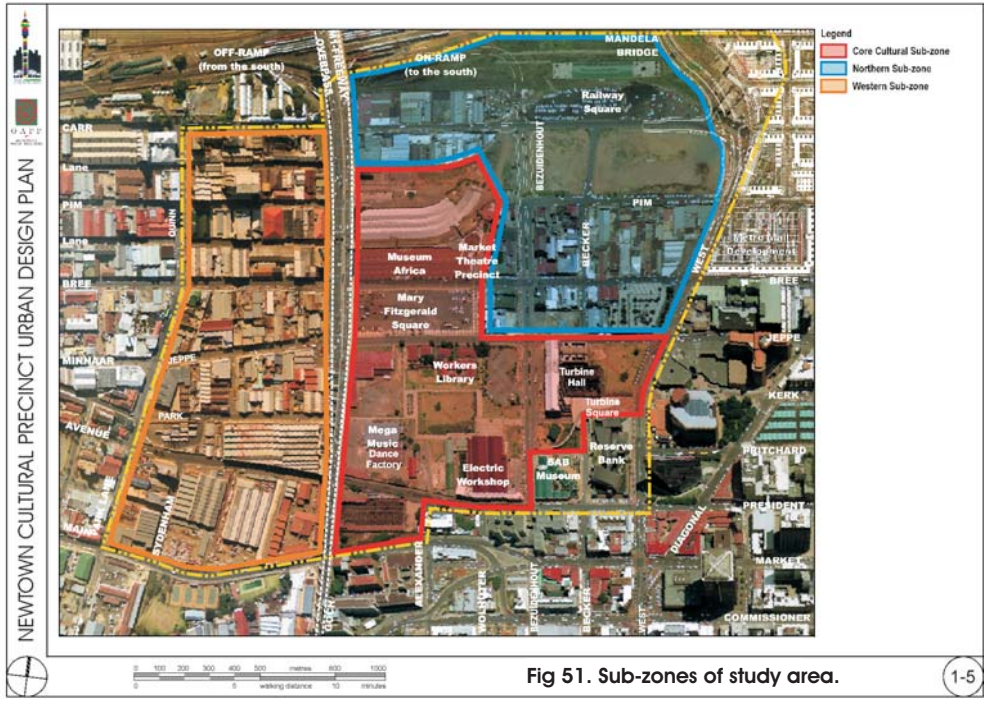


Fig 51. Sub-zones of study area.

The Precinct Plan Concept:

The spatial structure of the concept is based on an interlinked public environment system, which integrates the existing key activities and and creates further linkages to adjoining areas and activity clusters.
Three primary public spaces are interconnected by pedestrian dominant routes and lanes: Mary Fitzgerald Square, Newtown Piazza and Turbine Square. Additional pedestrian routes radiate from the core area, creating linkages to the Johannesburg CBD and Church Street (east), to the Oriental Plaza (west), to the proposed Craft Centre and the West City initiative (south), to the Transnet Railway Land and Braamfontein (north), and to the Metro Mall development (north-east).

This spatial structure establishes a dominant east-west redevelop-
ment corridor (past Turbine Hall). A secondary north-south development axis is created, established by the Market Theatre, Africa Cultural Centre and Museum Africa to the north, with further development opportunities including the Transnet Land Redevelopment and the proposed housing development. The southern part of the development axis is promoted by the Dance Factory and the proposed Craft Centre development.

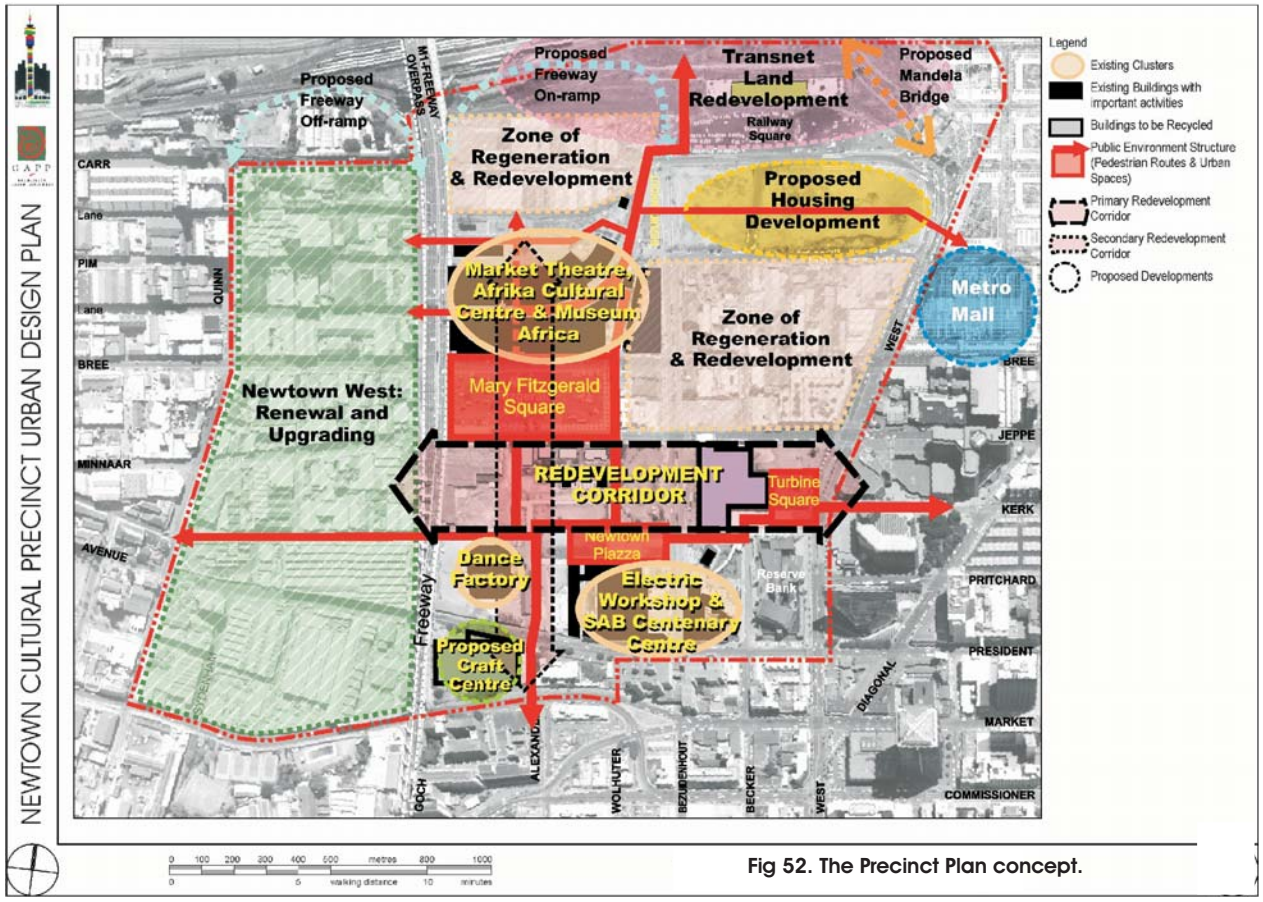


Fig 52. The Precinct Plan concept.

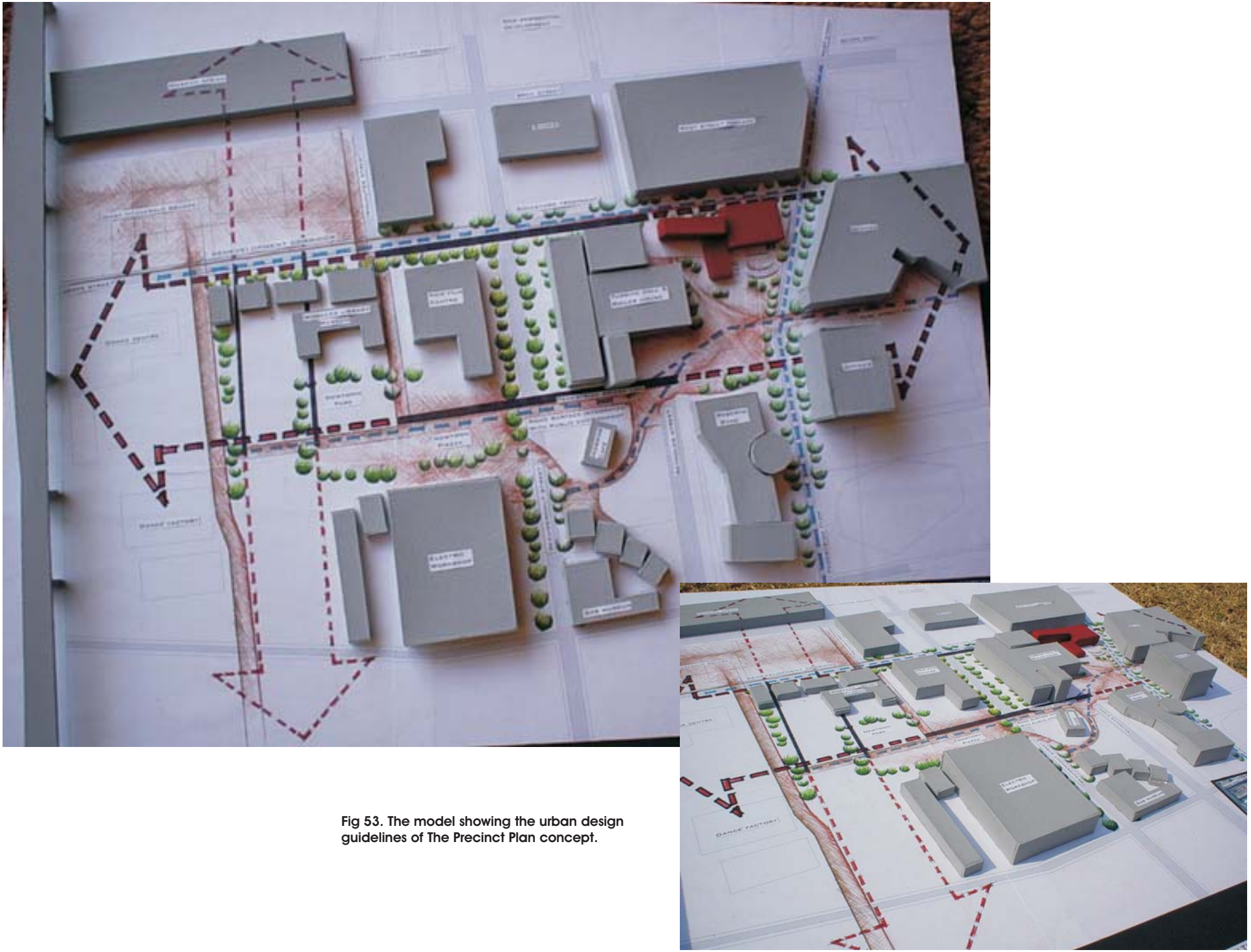


Fig 53. The model showing the urban design guidelines of The Precinct Plan concept.

The Precinct Plan Vision:

The development vision is based on creating a human-scaled, active and vibrant public environment, within a milieu of art and cultural activities, with supporting retail, commercial, business, office and residential uses.

Principles include:
• to accommodate pedestrians as the major form of movement and to emphasize a human scale to create a public environment in the Newtown Cultural Precinct;
• an easy, safe, convenient and pleasant pedestrian environment and movement, co-ordinated with ease of vehicular movement and access to well located and safe parking areas;
• extensive tree-scaping and landscaping for the promotion of a comfortable public environment;
• focusing on the need of pedestrians first, and ensuring that vehicular movement supports the diverse human activities that are envisaged;
• building on the distinct hierarchical road structure;

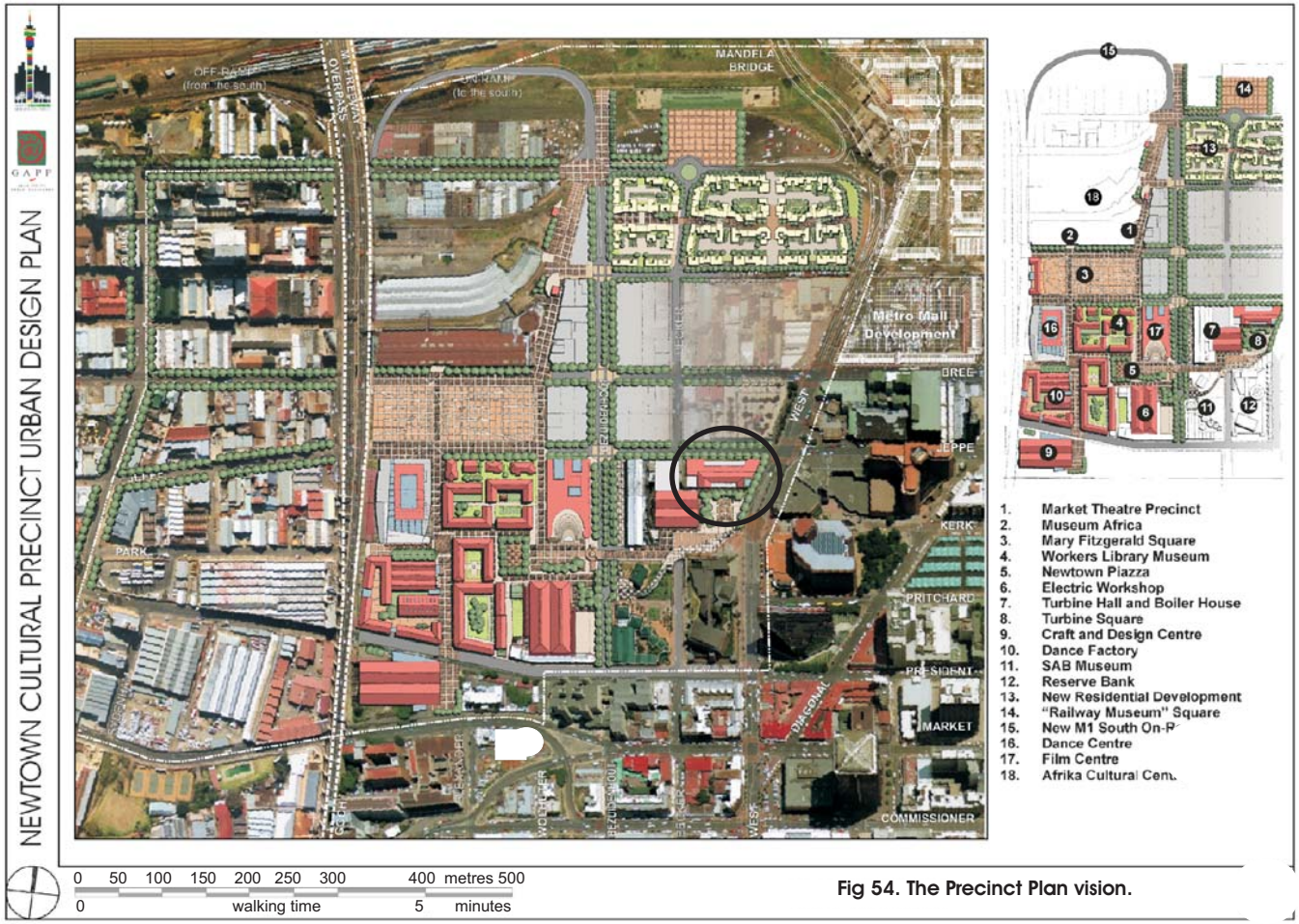


Fig 54. The Precinct Plan vision.

Land Use Activity:

The proposal is focussed on a mixed-use development within a cultural and art milieu, encouraging the complex integration of cultural, art, entertain-ment, retail, commercial, office and residential activities.

To maintain a sense of continuity and a vibrant urban life, there must be given attention to the activities and uses within buildings at ground floor level.
Ground floors are recommended to be used for retailing, entertainment, restaurants: uses that can flow out unto the sidewalk space adjacent to the building.

The uses and activities on the upper floors are to encourage looking out onto the public environment. Offices and residential uses must face outwards to the street. The use of balconies are encouraged.

Mixed-use developments are encouraged: active uses at ground level, two or three storeys of cultural uses above, and residential use at the
Top.

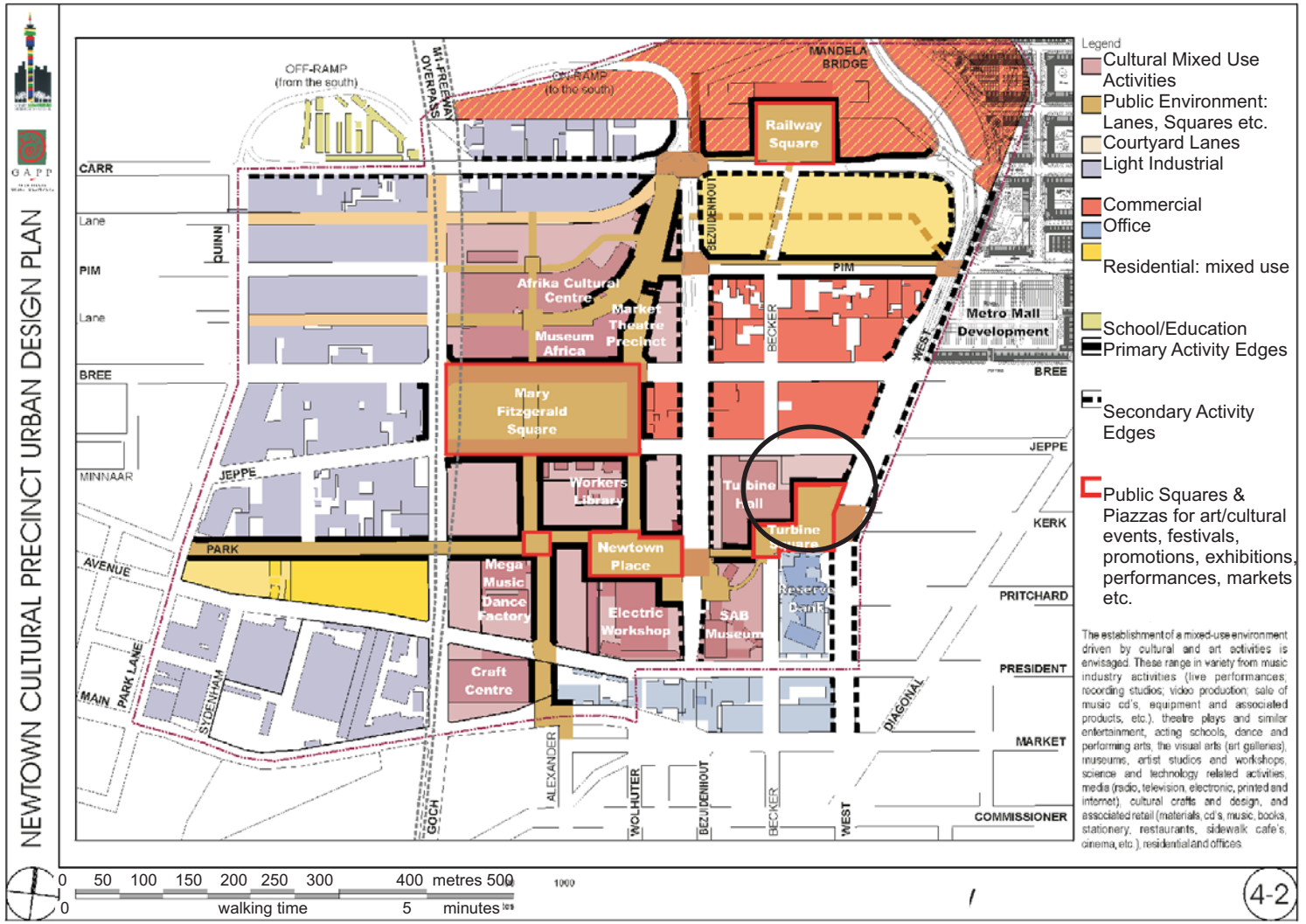


Fig 55. Land Use Activity (GAPP Architects & Urban Designers, 2001)

Built Form Directives:

- Designers are required to use their buildings to define space: buildings are used in group form to define the edges of the public environment.
- The buildings are encouraged to be designed to stand on their boundary lines and collectively form a human scale to achieve a feeling of containment and natural surveillance, ensuring safety and security.
- The mechanisms used to promote the built form: mandatory and desirable build to lines, building zones, and definition through colonnaded or covered walkways.
- Buildings and building facades of historical value are set aside for conservation. Historic buildings are to be retained and recycled. Historic facades must be retained and integrated with the redevelopment of the site.
- Height of the buildings are to be two to four storeys, in keeping with the existing urban environmental scale, and achieving a human scale of enclosure.
- The promotion of the development of landmark buildings with a distinct character. Architectural accentuation of buildings at important locations are encouraged. This promotes imageability and legibility.

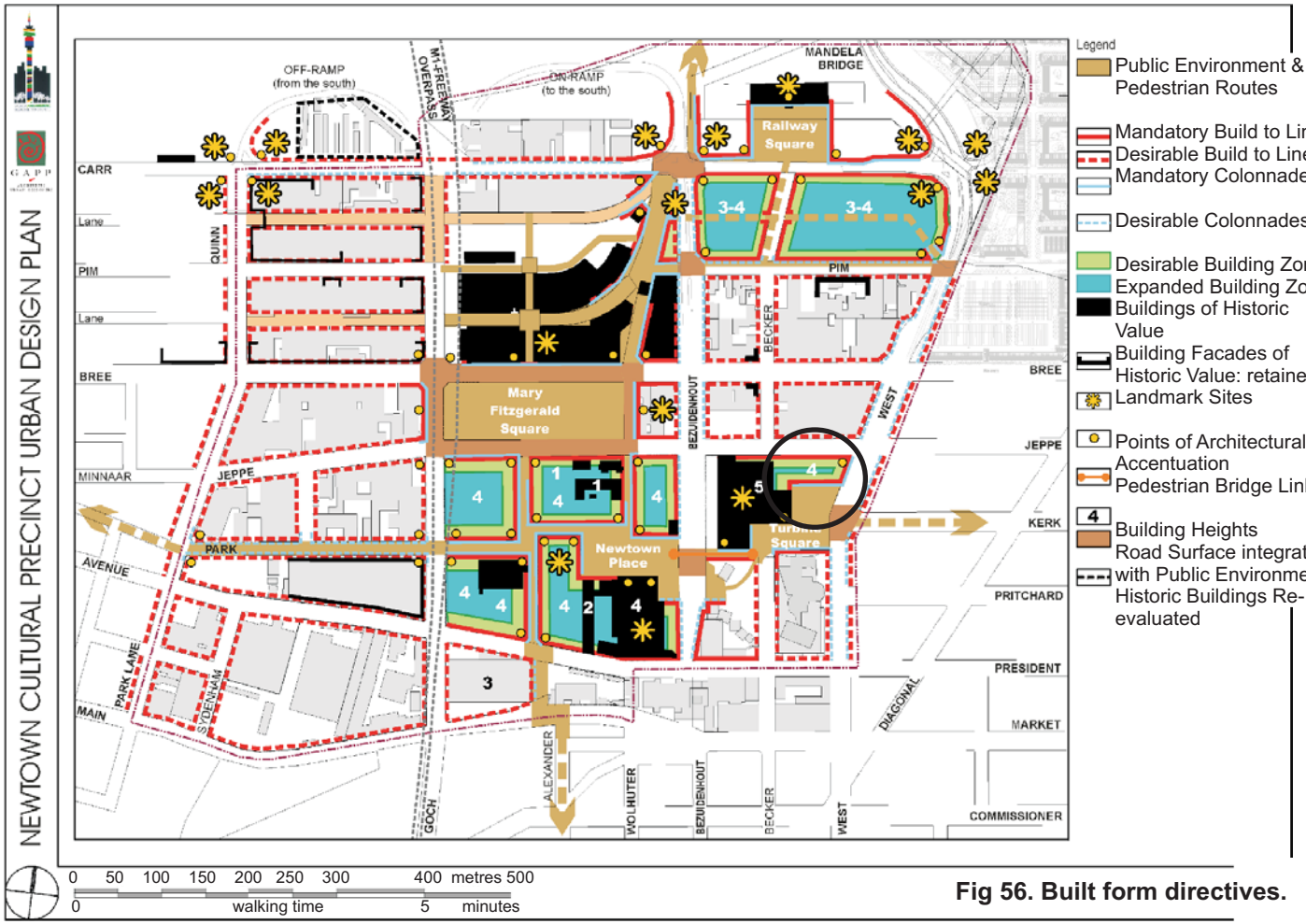


Fig 56. Built form directives.

Movement:

The proposed movement system is structured on a hierarchy of movement modes. These modes are separated but integrated: no rigid reservation of space for a particular type of movement is evident.

The movement is pedestrian dominated in a public environment. Controlled access of vehicles are accommodated. Public transport routes (taxi and bus) are proposed with stops at strategic intervals for maximum accessibility. These are integrated with the overall metropolitan- wide public transport system.

Vehicular Movement:

Two activity streets, or 'high streets' have been proposed: Carr and Bezuidenhout Streets. These streets are proposed to have more intensive retail, with significant on-street parking, wider pedestrian pavements, catering for entertainment, restaurants, daily needs and convenience shopping.

The rest of the roads form local secondary access roads, which provide circulation throughout the precinct, with on-street parking.

Public Transport:

Public transport routes and stops have been proposed. The routes consist of bus and taxi routes and have been routed that they fit with the existing public transport routes. The stops are located to provide easy access on foot throughout the precinct.

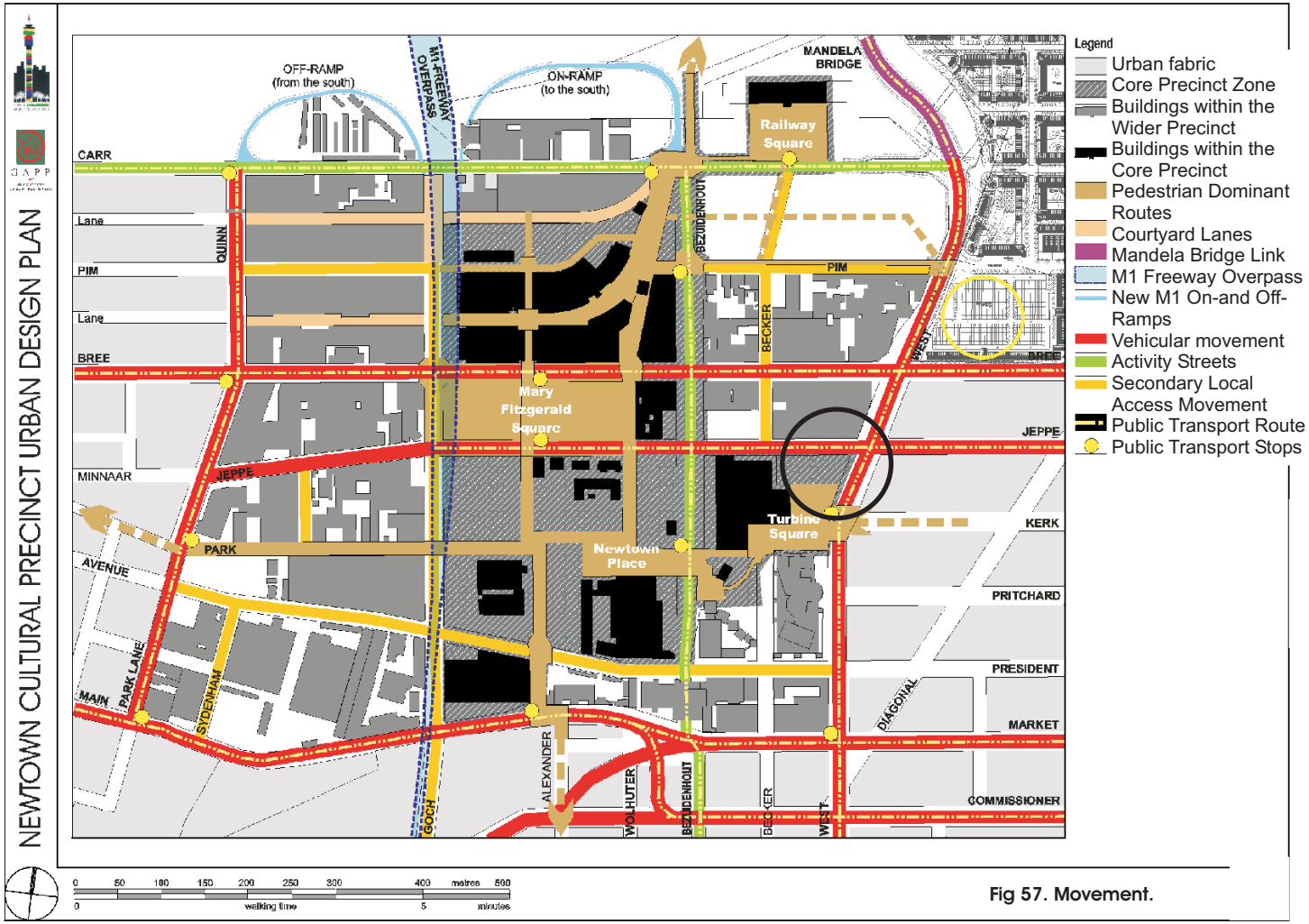


Fig 57. Movement.

Public Environment:

A pedestrian dominant public environment is proposed. The parts of Jeppe and Bree Streets along Mary Fitzgerald Square are to be designed as an extention of the square, with the aim of closing these streets during off-peak periods, at night, or over weekends, if required for an event.

Urban Space and Landscape:

The urban space environment is characterized by a network consisting of pedestrian walkways and routes, piazzas and public squares. Semi-public courtyard lanes have also been located, for the use by adjacent businesses for courtyard parking, landscaping and places of recreation.

The landscaping is structured to add to the aesthetics, legibility, sense of place, linkage and physical comfort of the environment. Elements used are:

- Formal planting of street trees along the primary routes to form boulevards.
- A secondary order of street tree planting to define areas of public environment, pedestrian routes and secondary streets.
- The utilization of formal -planters and landscaping features throughout the public environment.
- The use of 'soft' green spaces like local parks.

Colonnades and covered walkways have been proposed to enhance overall physical comfort and protection from the elements.

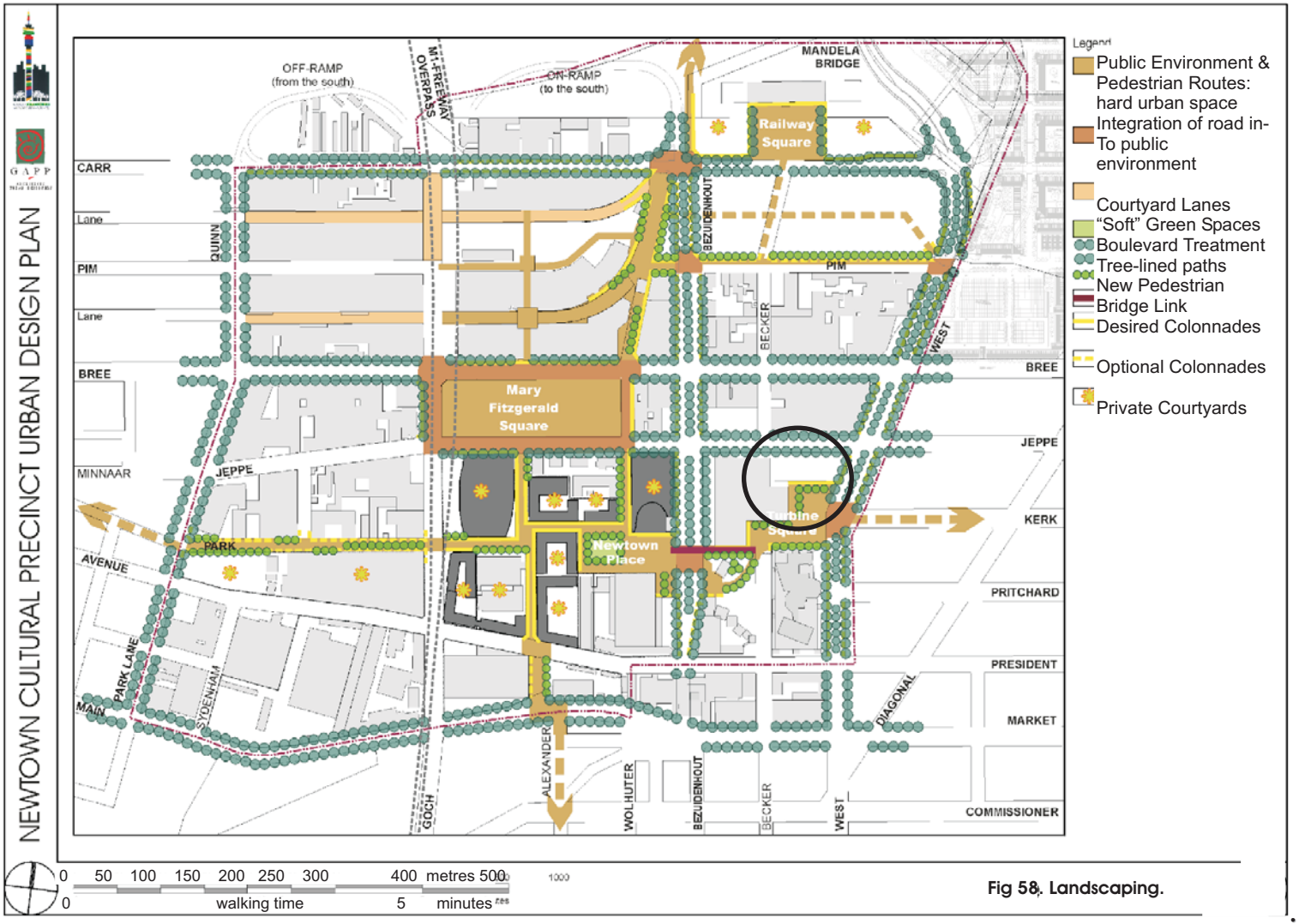


Fig 58. Landscaping.

Parking:

The parking requirements for the develop- ment are estimated to be in the range from 3600 parking bays at an average ratio of 3 bays per 100m2 of floor area across all uses; to 5500 parking bays at an average ratio of 4.5 bays per 100m2 of floor area across all uses.

Problems with provision of parking:
A significant amount of physical space is required to provide for parking. It is expensive to build a structured parking (basement). However, safe and secure parking, that is easily accessible, is required to attract people, which is critical to economic viability.

• Proposed Incremental Parking Ratio:

A sliding-scale parking ratio is proposed based on an analysis study of the Rosebank area in Johannesburg, undertaken by GAPP. Although the Rosebank parking study is not scientific in approach, it highlights the following principle: Mixed use developments encourage more complex activities within the urban environment resulting in a more dynamic and more efficient use of the provided parking facilities. The result is an overall lower parking ratio.

The sliding-scale parking ratio proposed:

Floor Area Ratio cumulative bays/m2	**bays/m2**
For the first:	
0.5 FAR	1bay/20m2
5.0/100m2 cumulative	
Thereafter to:	
1.0	1 bay/22m2
4.5/100m2 cumulative	
To 1.5	1bay/25m2
4.0/100m2 cumulative	
To 2.0	1bay/29m2
3.5/100m2 cumulative	

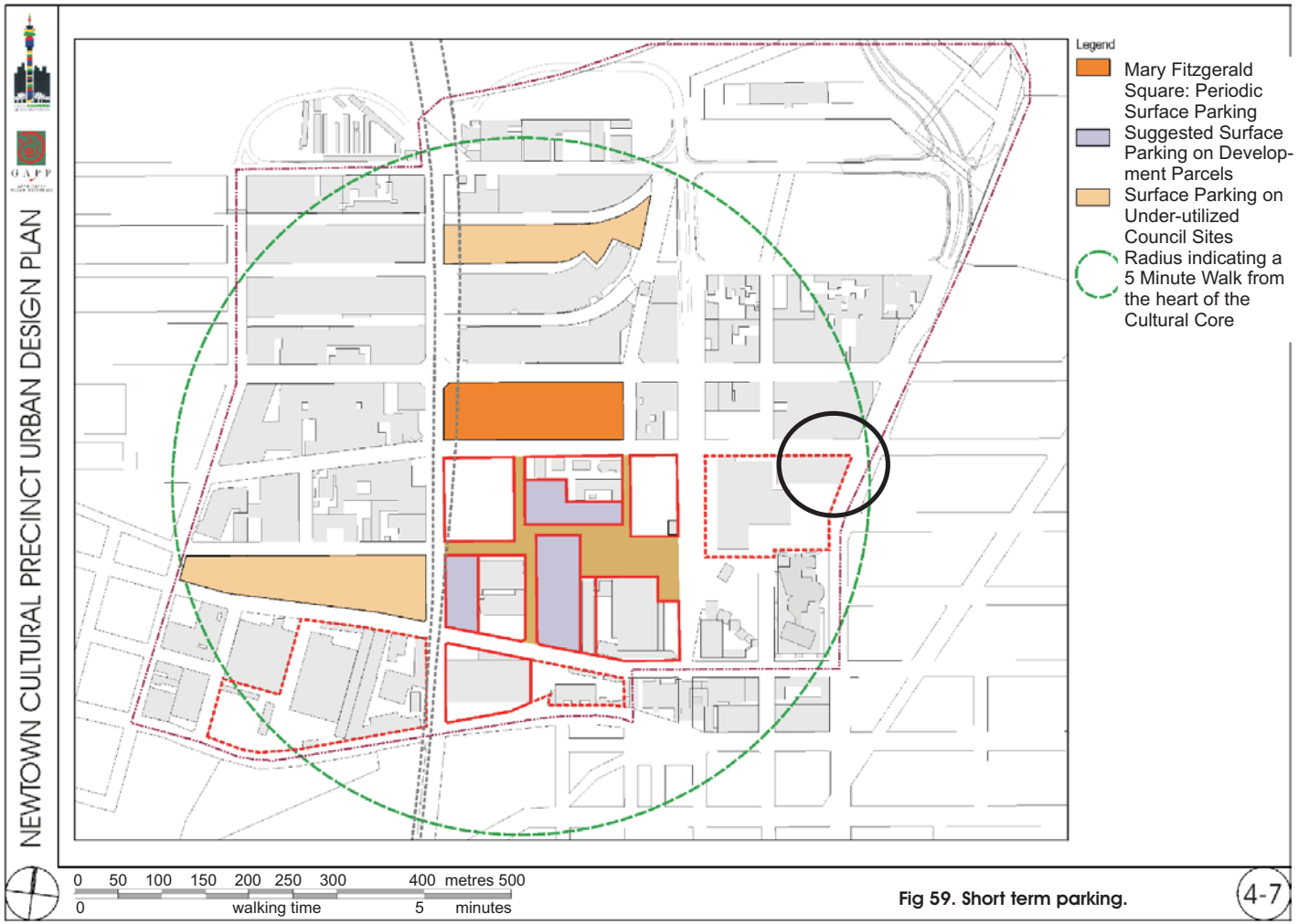


Fig 59. Short term parking.

4-7

Short-term parking:

Short-term parking is to be accommodated on-surface on the undeveloped sites and under-utilized Council land. Space for this is to be made available in an incremental manner.

Once all available land has been used for parking, and physical redevelopment begins to reduce the parking, the long term parking strategy should be initiated.

The following areas are pointed out for short-term parking:
- On -surface Mary Fitzgerald Square.
- On-surface on the development parcels of the precinct, which have presently no development proposals.

The minimum amount of parking available within the precinct in the short-term is approximately 928 bays.

Long-term Parking:

Parking over the long term is to be accommodated as follows:
- Structured parking: most developments will require a minimum of one parking basement, and some will require two basements.
- Mary Fitzgerald Square will accommodate public surface parking.
- Parts of the Turbine Hall buildings' basement can be redeveloped into a public parking facility. This will depend on the proposed redevelopment of the building.
- A public structured parking facility (above surface) should be developed in the vicinity of the new on-ramp on to the M1 freeway.
- On-street parking will also be available.
- Parking becomes available in the evenings at the West Street Parkade.

Fig 60. Long term parking.

Development Design Guidelines:

The intention of urban design controls is to ensure the development of a cohesive urban environment that responds to its urban and topographical location, to the goals and experience of Newtown, and which can act as a framework within which architects and/or developers can contribute positively to the urban form as agreed by the Johannesburg Development Authority. [Gapp Architects & Urban Designers, 2001]

The following guidelines were given in the framework to set the architectural goals that would be recommended within the Newtown Cultural Precinct.. Structure and character of the architectural form need to be guided so that it can be read through its movement systems, urban spaces and building forms.

Architectural Character:

• The urban design controls will, to an extend, control the form and size of buildings and their relationship to one another and to the hierarchy of open spaces proposed. This will ensure a consistent integrity of urban form.
• A design code is required to prevent design deviations in the wrong direction, but permits the occasional flight of fancy that does enrich towns. The juxtaposition of more formal spaces, places, routes, landmarks, vistas, topography and interesting buildings conceived that makes memorable precincts, such as Newtown.

Design Ethic:
• Buildings must define space, rather than be objects within it. The built fabric should be defined by:
- High Floor Area Ratios
- Minimum heights that achieve an acceptable degree of enclosure of the public environment
- Definition of build-to-lines ensuring strong edges.
- Minimum design criteria that accentuate the building's relationship to the public environment, its point of entry, parking, vehicular circulation, security, massing of built form, elevational and roof treatment, façade modulation, vertical composition and relationship to adjacent developments, in particular active ground floor activities.
• Buildings must recognise their context, be respectful of neighbours, and enrich public, semi-public and private environments. Pure copying of historical styles is discouraged, but analysis and reinterpretation of historical clues must be encouraged. The thrust of the architectural ethic should be an enduring, timeless quality.

Materials and Quality:

• High quality materials should be used, which can also be cost effectively maintained.
• The area is characterised by red brick and earthy colours. Materials of this colouring are encouraged.
• Materials and elevations should reflect a consciousness in respect of energy and water conservation.
• Roofs must be dealt with as a conscious element of façade treatment. Roofs should not dominate their buildings.

Relationship to Surrounds:

• The overriding group form sought is that of a *street-related wall architecture*, as is characteristic of the Johannesburg CBD. In other words, urban spaces must be lined by a continuous façade of buildings. While heights, build-to lines, and architectural styles may vary slightly, the net result should be a complex façade facing onto the public environment.
• Continuity of building is encouraged, with gaps between them being discouraged.
• Buildings must relate to each other, to the interior and exterior.
The interior of each block should be considered with importance, as a place within its own right. It should form an important ingredient of the semi-private domain of the Newtown Precinct. The development of each site / erf should recognise it as an equally important frontage and respond to it accordingly.

Mixed Use Development:

• Quality of life, ambience and activity in the area is dependent on the extent to which mixed-use developments are achieved. There is therefore a high priority on encouraging developers to respond in this regard.
• Continuity of a vibrant ground level is encouraged, for example, retail, restaurant and entertainment activities. Cultural activities are equally important here, such as theatres, galleries, and workshops.
• Sidewalk space becomes an important element in the architecture of a building. Colonnaded, canopied or protected sidewalk space becomes an important determinant of the adopted architectural approach. Enclosure of the sidewalk should be of a human scale.

• Ground level facades must interact with street if they are not to be used for active spaces. This will allow for surveillance and thus security.
• The ideal mixed-use configuration is that of retail-related active uses at ground floor; with offices and studios two or three storeys above this, and one or two more levels of residential apartment above this.
• Densities must be maximised where possible.

Celebrate Entrances:

• Pedestrian entrances and circulation should be clear and emphasised, both from the street and the inner core of the block. Thus the building becomes a double frontage development.
• A hierarchy of spaces ranging from public to private must be encouraged.
• The area must be as user-friendly and as accessible as possible to all people, regardless of disabilities. Thus ramped access to buildings should be an integral part of the building's sense of arrival. Specialised facilities for mothers and their children, the elderly and the disabled would be welcomed.
• Vehicular access across sidewalks must be limited if possible.
• Corner buildings must be given particular attention, in terms of stature, by way of accentuating height and details.

Signage:

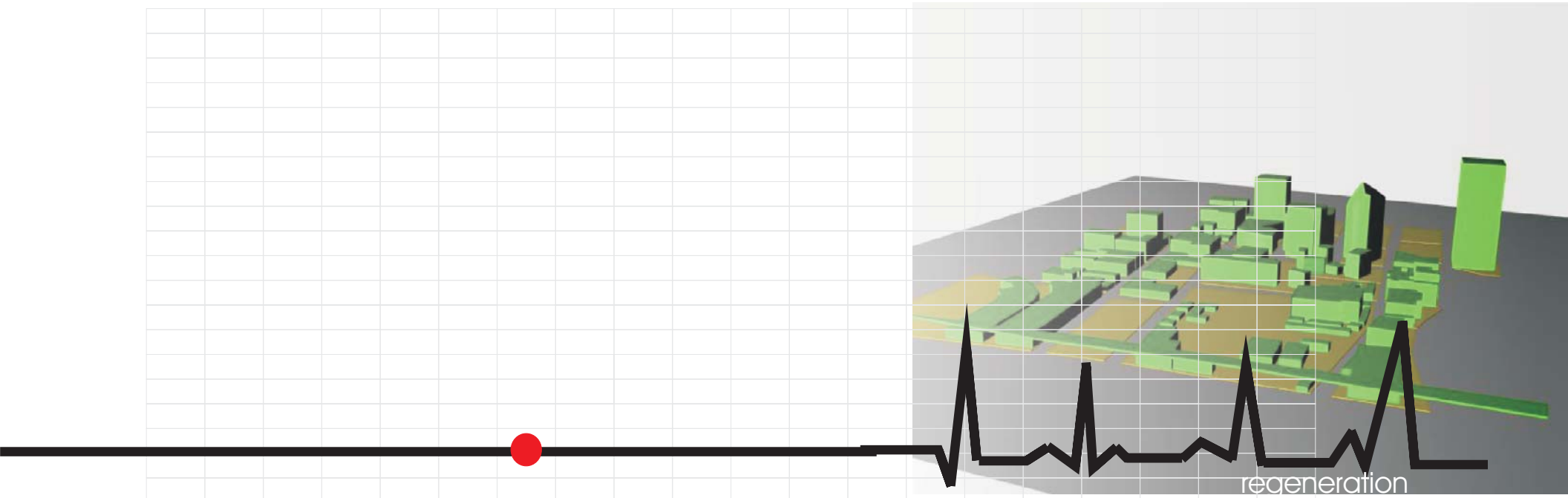
• Designated zones are needed for signage that is visible to public, semi-public or neighbouring property.
• Discreet and restrained signs are encouraged, in other words, no flashing or moving signage should be allowed.
• Approval must be obtained for the display of external signs.
• No signage may appear on the façade above ground, other than the name of the building.
• Signs should be manufactured of high quality, durable and colourfast materials.
• Fixed elements of the sign should be concealed.
• Signs and support structures are to be ground related and integral to the building.

Landscaping:

• Landscaping is used to enhance the architecture of the building and to create a greening of the city fabric and to emphasise the relationship between built and natural elements.
• Landscaping must complement that of adjoining sites to create a unified landscape running across boundaries rather than defining them.
• The utilisation of indigenous planting is encouraged and is to be designed with a conscious attention to routine maintenance.
• 20% of the site's area (hard and soft landscaping) must be professionally planned and detailed.
• Planting must be properly maintained and irrigated. All hard surfaces must be designed to accommodate proper storm water drainage.

[GAPP Architects and Urban Designers, 2001]

site analysis



University of Pretoria etd - Potgieter, H (2003)

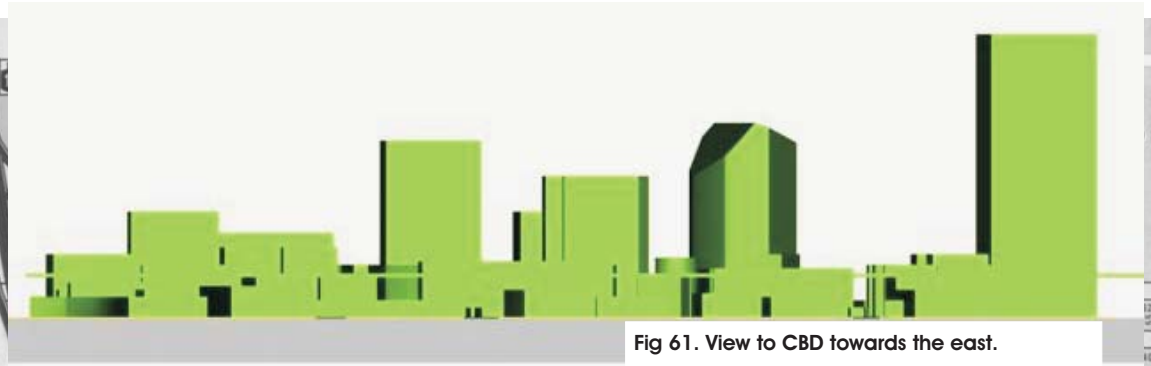


Fig 61. View to CBD towards the east.

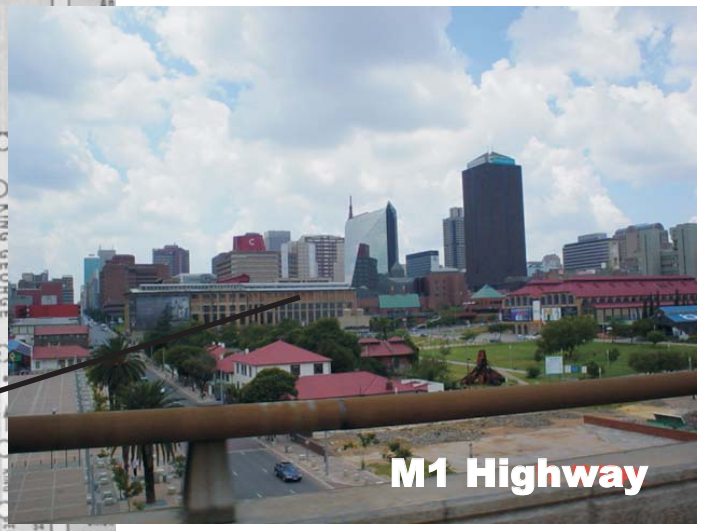
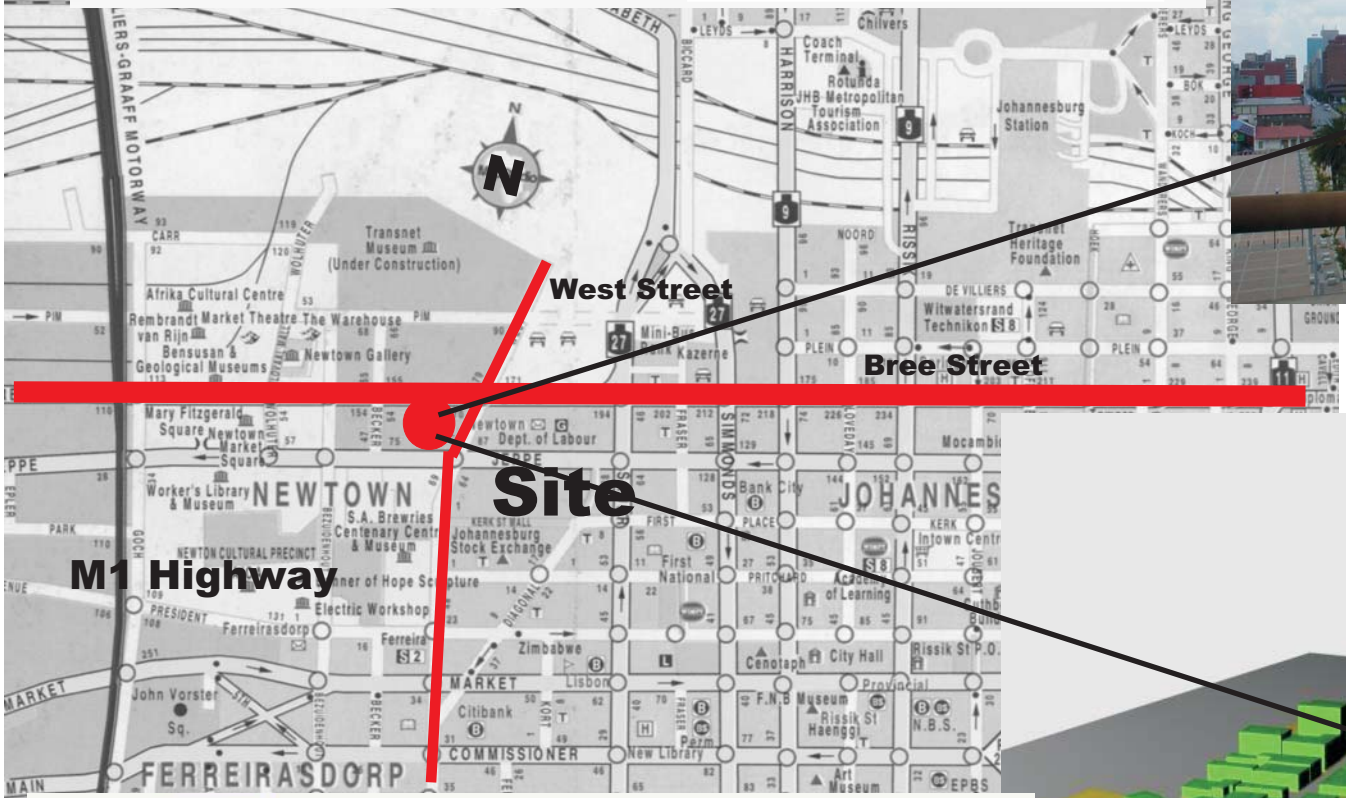


Fig 62. View to CBD towards the east.



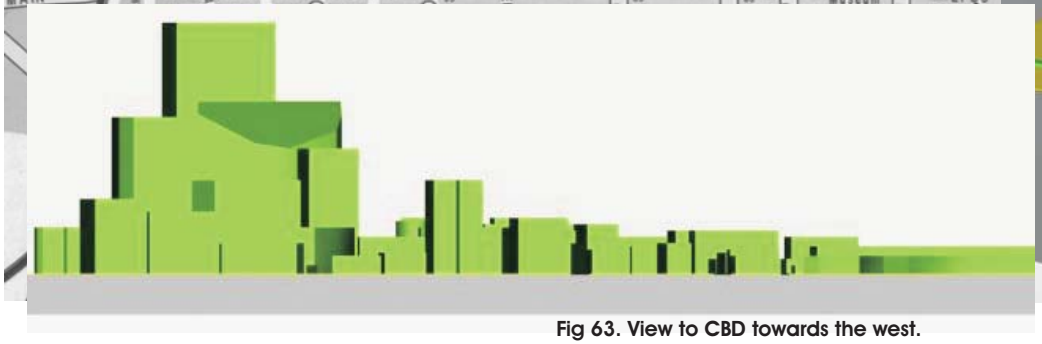


Fig 63. View to CBD towards the west.

Fig 64. Site location.

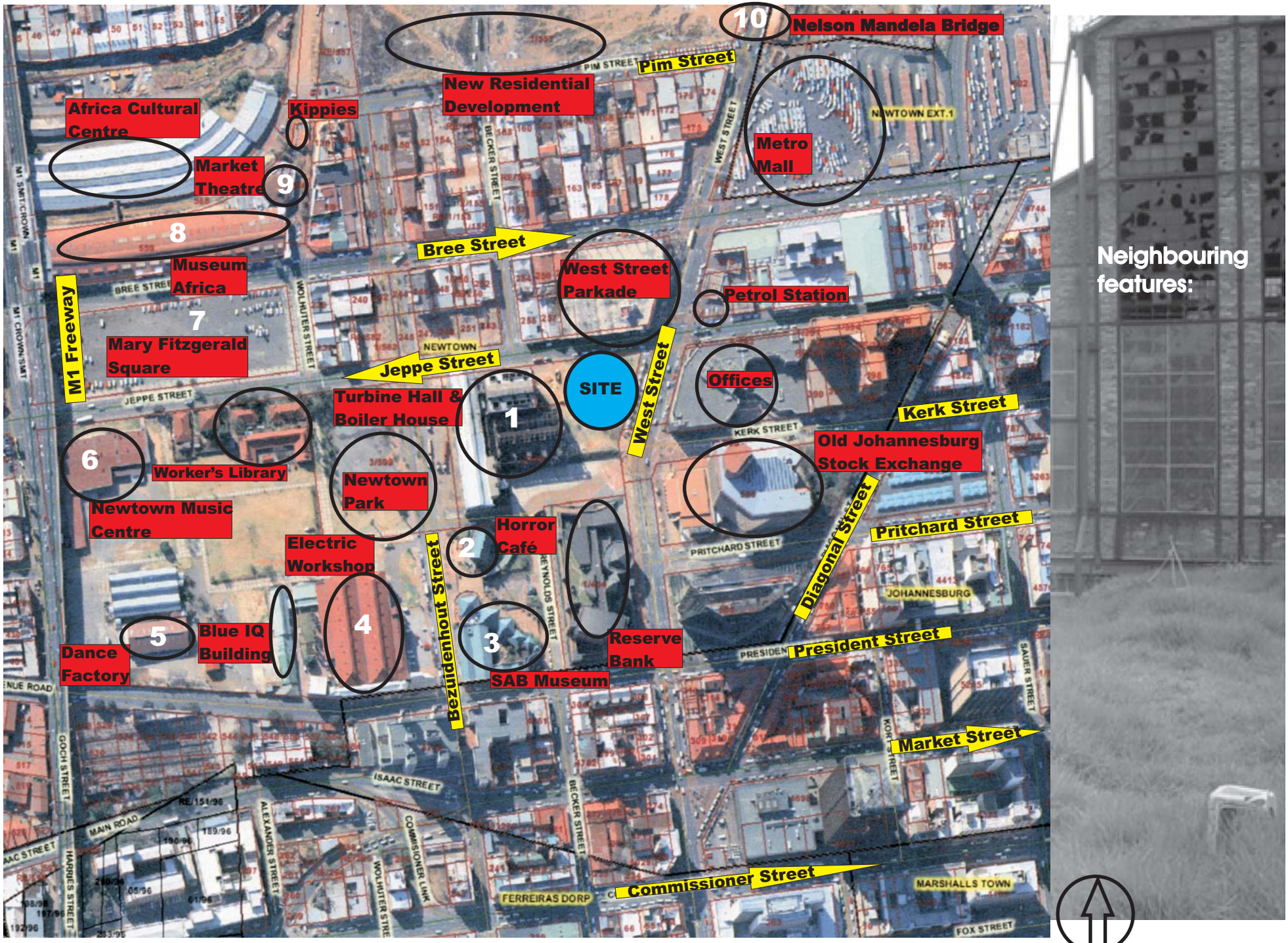


Fig 65. Neighbouring features.

Fig 66. Model of the Newtown precint.

Fig 67. The Turbine Hall.

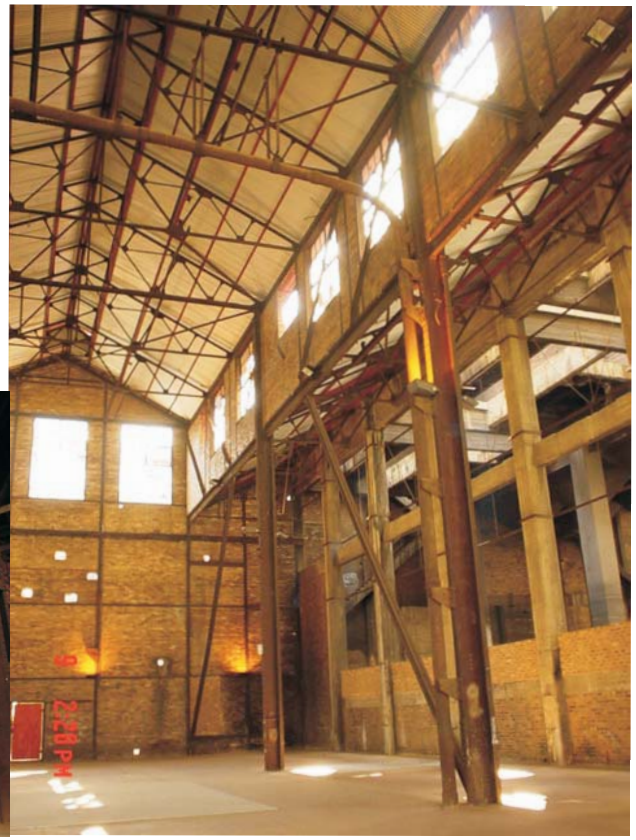


Fig 68. Renovated Interior of the Turbine Hall.

Turbine Hall:

The Turbine Hall situated on the corner of Jeppe and Bezuidenhout Streets is probably one of Johannesburg's most striking ironies and mysteries. The Turbine Hall was home to Johannesburg's first coal-fired power stations. In its heyday just the room, which houses the turbines, was the largest building under a concrete roof in South Africa. The history of the hall is uncertain. It is said to be built around the 1920s [Turbine Hall Set for a Jol, 2003] when the Newtown markets were established.

In 1904 a plague broke out among the poverty stricken Indians who lived in the area now known as Newtown. The people were moved to Klipspruit, the district was named Newtown and the town council started building a business district there, complete with abattoir, livestock market and a fruit and vegetable market. Then followed the construction of the Electric Workshop, the power station and the Turbine Hall. These buildings powered the city's electric trams and all of Johannesburg.

When black people heard the halls howling siren during apartheid they had to vacate the city at seven pm or face the wrath of the police. The siren marked the curfew to the black workers to be bussed out to their homes in Soweto and banned from the city.

The four electricity cooling towers in Jeppe Street, used to cool water for the power station, were constructed between 1935 and 1937 [Turbine Hall Set for a Jol, 2003]. Decades later these large structures served as a landmark to anyone traveling on the M1 freeway to and from Johannesburg.

Eventually the Turbine Hall became inoperative. Life sizzled out of the generators and the city's electric department moved office. Age too took its toll on the cooling towers and by 1985 their concrete was flaking and they were in a state of disrepair. Despite of hopeful talk of transforming the towers into new-age hotels or an art gallery they were demolished in June 1985 [Turbine Hall Set for a Jol, 2003].

Fig 69. View to Turbine Hall from the pedestrian bridge.

Fig 70. Music festival held at the Turbine Hall.

Fig 71. View to Turbine Hall from West Street.

The Turbine Hall stood still and empty, rooted to the city like an urban survivor. After being gutted by fire, its brooding skeleton became home to the city's homeless and a way for them to make money. About 300 homeless people used the hall's domains to recycle cardboard, paper, plastic and tin cans during the 1990's.

During this period the city's engineers embarked on an ambitious plan, roumered to cost about R300-million to transform the area into a thriving retail square, called Turbine Square, but the plans were rejected an the project doomed 'too ambitious'.

As businesses left to areas like Sandton, taking their money with them, and the city declined. The Turbine Hall fell into ruin and became a den of drugs and crime. In 1999 the hall was a seen of a series of muggings, rapes and murders, including that of a Homeless Talk writer. Criminals used the hall's numerous dark passages to evade authorities and build elaborate tunnels from which to steel copper cables from nearby businesses. The city council razed the shacks in July 2000 and evicted the squatters.

Anglogold, the gold mining company, offered a chance of salvation when it stated that it might move its offices to the hall, but nothing came to fruition. When the city's urbanites were interrogated about the future of the hall, some suggested it to be used as an Inner City housing project, an upmarket boutique, a market place, a concert hall, an ice-skating rink or a children's home. None of these proposals realized. It seemed as if there was nothing but a false hope for the Turbine Hall until recently.

After the turbulent and sorrowful past, this landmark has finally found its rightful identity Johannesburg's newest music venue. During the World Summit on Sustainable Development, 2002, the hall was hosting veteran artists such as vocalist and guitarist Vusi Mahlasela, Judith Sephuma, P J Powers, Jimmy Dludlo and Selaelo Seloto.

A total of R5-million was spent from council funds to make the southern boiler house a suitable music venue, but a great deal of work still needs to be done to restore the other two connected venues, the Link Building and the northern Boiler House. Most of the work on these two venues is of a structural nature and will be completed at the end of 2003. The R25-million needed for upgrading is made available by the Gauteng Provincial Government.

The 'industrial' theme the Johannesburg Development Agency wanted to develop has worked well. Not only has the approach of raw brick and steel saved the council money, it has also enhanced the Turbine Hall's unique charm broken windows and all.

The finished Turbine Hall will hold up to 4 000 people. The other buildings will host photographic and fashion shows as well as musical events. . The new toilets capture the stark, urban industrial feel. This enabled the installation of a generous amount of toilets to prevent queuing outside the toilets.

The southern Boiler House was given the green light from a safety point of view. The polythene and wood panels covering the lower windows are only temporary. The windows of the other buildings pose a safety problem of glass falling down. A solution is to cover up the broken windows with sheets of safety glass on the outside, thus retaining the charm while addressing the concerns around safety.

The Turbine Hall received quite spectacular lighting to make it a round-the-clock landmark in Newtown. The building is now lit up from the inside and the outside. With lights kept on all night, the Turbine Hall is clearly visible from the M1 highway.

Fig 72. The Horror Café.

Horror Café:

This club/restaurant is open for lunch and dinner. Every week patrons can experience anything from drum 'n base, reggae, house music or break-dancing to documentaries and visuals.

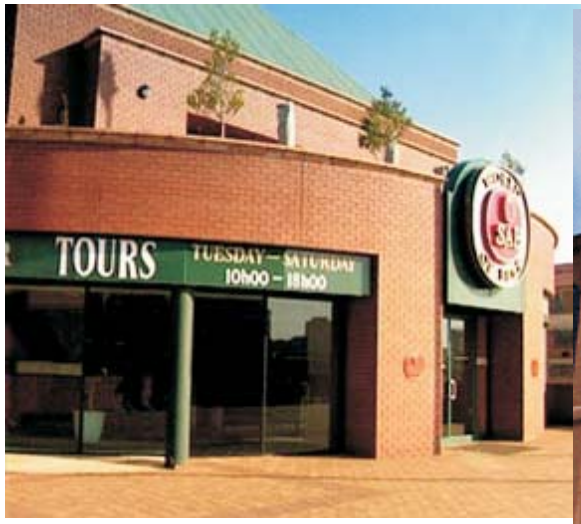


Fig 73. South African Breweries Museum.

South African Breweries Museum:

The SAB Museum celebrates 100 years of beer brewing in South Africa through exciting, interactive displays, memorabilia and beer tasting events.

Fig 74. The Electric Workshop.

Electric Workshop:

The Workshop is one of the earliest buildings in Johannesburg, which once powered the city's earliest trams. This spectacular space was built in 1929 to house a generating station and municipal workshop for Johannesburg's department of electricity. Its distinctive facade and interior were renovated a few years ago to serve as a multi-purpose venue for cultural events in Newtown. Dramatic reminders of its former use are clearly visible.

Fig 75. The Dance Factory.

Dance Factory:

At the Dance Factory you can see work of young South African choreographers, or take part in an African dance class, a creative movement class, a ballet class, or watch anything from Spanish dancing through to ballet, to gumboot, tap modern or a combination of all of them.

Fig76. Mary Fitzgerald Square.

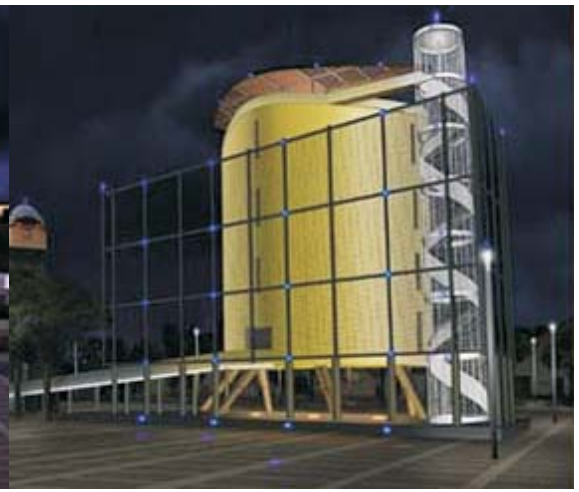


Fig 77. The Square lighting scheme.

Mary Fitzgerald Square:

Mary Fitzgerald Square lies at the heart of Newtown. Named in honour of the first woman trade unionist who played a key role in the miners' strikes of the 1910's, the Square has been refurbished and upgraded. Work on the Square began in July 2001 and was opened with a special jazz concert on 17 December, 2001. Its completion was a major milestone in the progress of the Blue IQ's inner city projects.

Located opposite the MuseumAfrika and the Market Theatre, the Square is approximately 29 000 square metres and will accommodate roughly 22 000 people. Built at a cost of approximately R14 million the Square provides a place for people to interact, and a range of related functions such as flea markets, exhibitions, concerts and similar open space activities to take place.

The brick-paved square is meant to be a pedestrian area although the western section of the Square is used for parking. The French Government has funded the Square lighting design, schemes being put forward by European lighting designer - Patrick Rimoux. Proposed landmark towers would make use of variable lighting to provide different effects and make the structures visible throughout the day. These towers will also be employed as viewing platforms for productions. Proposals for ground lighting and specially-designed lampposts have also been created. The lighting will be manufactured in South Africa and an electrical engineer contract is under evaluation.

Newtown Music Centre:

The refurbishment of the Centre was one of the infrastructure developments undertaken by Blue IQ. The Centre was renamed the Newtown Music Centre and allows for a 'one-stop shop' for musicians, emerging artists and other industry practitioners who need information, training in live performance skills, studio facilities, rehearsal rooms and resource networking for the South African Music Industry.

The Centre will be run by the Music Industry Development Initiative (MIDI) Trust which was awarded the tender to operate this venue. The MIDI Trust was established in October 1996 to assist in developing the South African music industry.

Talks have been held with Kaya-fm to move into Newtown. MIDI Trust has also moved into the Centre, where it will host events.

Fig 78. Museum Africa.

Fig 79. The Market Theatre Precinct.

Museum Africa:

The museum charts the history of our land using expert geology, archeology, anthropology and history to weave together the story of South Africa in an existing creative way. Photographs, paintings, prints, needlework and music help to paint a complete experience for visitors.

Market Theatre:

The internationally acclaimed African Bank Market Theatre, which played a critical role in the struggle against Apartheid in the 1980's by encouraging debate and challenging ideas, is a vibrant theatre complex, housing three theatres, a theatre bar and art gallery. This is a favourite destination for residents of and visitors to Johannesburg.

An old fish and vegetable market, it still retains the ambience of the market place, and is suffused with theatrical history, from the posters of Athol Fugard plays that had their first performance here, to Grammy and Toni Award musicals like 'Sarafina' and 'Kat and the Kings' that started here.

The Market Theatre Precinct is also home to the Gramadoelas Restaurant, specializing in South African cuisine, and Kippies, a renowned jazz bar which specializes in local jazz and afro fusion, with some top local and international artists dropping in for sessions.

Fig 80. Unveiling of the model of the Nelson Mandela Bridge.

Nelson Mandela Bridge:

The construction of this multi-million rand bridge, named after former President Nelson Mandela, began in September 2001. This 295 metre-long bridge is also part of the redevelopment plan for Newtown. The bridge will be the country's largest cable-stayed bridge. The bridge will provide a link between Braamfontein and Newtown, thereby providing easier access to Newtown and the Johannesburg CBD for people coming from the north and west of the city. The bridge and the associated road works jointly referred to as Braamfontein-Newtown Link will connect Bertha Street in Braamfontein with West Street in Newtown.

A model of the bridge was jointly unveiled by former President Nelson Mandela and Gauteng Premier Mbhazima Shilowa in Newtown on 16 July, 2001. The bridge is said to be completed by March 2003 and to be launched on Nelson Mandela's birthday on 17 July 2003. Once built, the Bridge will become a city landmark with its dramatic design.

Further infrastructure development includes the construction of the M1 Carr Street interchange, a project that will see the creation of an on-ramp and off-ramp linking the M1 South and M1 North to Carr Street. The interchange is scheduled for completion on September 2002. The tender to build the interchange was won by Siawela Joint Venture - a venture between Wilson Bailey Ovcon and Rainbow Construction Company. The South African National Road Agency,which overseas the entire project, appointed Keeve Steyn and Goba Moahloli Joint Venture to proffesionally manage the entire project.

Voorstad in Jhb herwin eertydse glorie

JOHAN EYBERS
Johannesburg

Braamfontein is besig om sy status as die vooorste kultuur- en sakegebied in Johannesburg te laat herleef.

Nuwe verbindingsroetes tussen Braamfontein en Newtown is reeds geskep met die Nelson Mandela-brug.

Plasmine is ook goedgekeur waardeur 'n kultuurgebied tussen die konstitusionele hof, die Stadskouburg, die Universiteit van die Witwatersrand se kunskool en Witstester geskep gaan word.

Me. Monica Albonico, 'n stadsbeplanner, se Wits wil die gebied langs die universiteit en Jan Smutsrylaan verbeter met voetgangersones en parke sodat dit met die konstitusionele hof verbind kan word.

Dit sal teen Julie voltooi wees wanneer die Nelson Mandela-brug geopen word.

Daar is ook reeds begin met bouwerk in Ameshoffstraat om die ondergrondse parkeerplek by Sappi se hoofkantoor met die Stadskouburg te verbind sodat nagenoeg 350 bykomende parkeerplekke vir teatergangers beskikbaar sal wees.

Amonstraat is reeds geskuif om dit in 'n voetgangersone om die teater te verander.

'n Restaurant en 'n verhoog en musiekkonserte word later hier beoog.

Wits se kunskoekel en die Stadskouburg beplan elkeen 'n eie openbare kunsaal.

Die ontwikkeling van R200 miljoen by die Stadskouburg is nog 'n poging om Braamfontein tot sy vorige glorie te herstel.

Die stadsvaders beoog om die Heartland-ontwikkeling, wat tans net uit gay-nagklubs bestaan, uit te brei en hotels en woonsteleeboue hier op te rig.

Braamfontein is steeds 'n gesogte voorstad en net 11,85% van sy kantoorruimte staan leeg.

Volgens ApexHI Properties is die besetting baie hoog vergeleke met die res van die stad, waar sowat 'n kwart van die kantore leegstaan, en met ander sakegebiede soos Parktown (21,88%), Rosebank (15,71%), Rivonia (19,11%) en Sandton (15%).

Altesame 70% van die kantoorruimte van Total House, op die hoek van Rissik- en Smitstraat, het twee jaar gelede leeggestaan.

'n Groot fekenaarfirma, twee staatsdepartemente, 'n vakbond en 'n afdeling van Transnet en Johannesburg se parke-afdeling het intussen hier ingetrek. Nou is 98% van die gebou beset.

Mnr. Nthatisi Modingoane, woordvoerder van die Johannesburgse stadsraad, sê die sukses verbaas kan toegeskryf word aan Braamfontein se vermoë om homself te herontdek.

Die Nelson Mandela-brug het as nuwe baken opgeskiet in Braamfontein, wat besig is om sy status as die vooorste kultuur- en sakegebied in Johannesburg te laat herleef.

Foto: ANTOINE DE RAS

Fig 81. A news article in Rapport on the Nelson Mandela Bridge, 23 March, 2003.

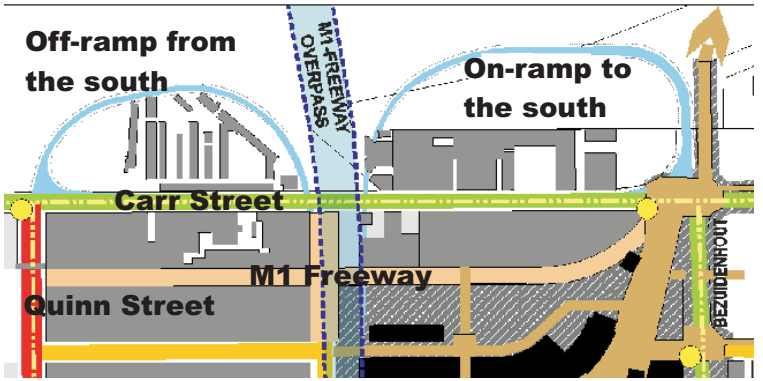


Fig 82. The M1-Carr Street interchange.

Fig83. The Metro Mall during construction.

Fig 84. Colourful murials at the Metro Mall.

Fig 85. The new housing development.

Metro Mall:

The metro Mall facility on the corner of West and Bree Street is a transport interchange and trading facility established to serve as a market place for Johannesburg's informal and formal traders as well as a rank for taxis and busses carrying commuters into and out of Johannesburg. The massive structure has three blocks: the first one is for subsidised housing. The second block consists of taxi ranks, hawkers' stalls, shops and fruit and vegetable market. The final block has a taxi rank, a bus terminus, hawkers' stalls and space for retailers and wholesalers.

The development serves the needs of the 150 000 taxi and bus commuters passing through Johannesburg. It is built to accommodate 2250 taxis and 100 busses at any given time. The Mall is a trading hub for about 450 informal traders, who are trading side by side with formal retailers in a healthy and competitive environment. To diversify the products sold at the market, preference is given to people who sell unusual goods. Fast food outlets are a big feature in the Mall. The project is worth R140 million and is one of the Blue IQ infrastructure projects. The formal retail space comprises a total space of 2832 square metre of which 2000 has already been allocated.

The Mall is designed and maintained in such a way that the safety and security of users is paramount. The Mall has facilities like closed circuit cameras and security personnel on guard throughout the day. It also has fire protection equipment, storage facilities for informal traders, electricity, water, ablution facilities, preparation areas, manufacturing space for craftsmen and lock-up units for goods.

New Housing Development:

In the next three years 2200 housing units will be built in Newtown. The developments will be targeted to mixed income markets, thereby encouraging diversity and sustainability. Some 1050 of the total number of housing units are to be subsidised, while the remainder will be developed to target earners within the middle-income bracket.

Fig 86. View towards the east.

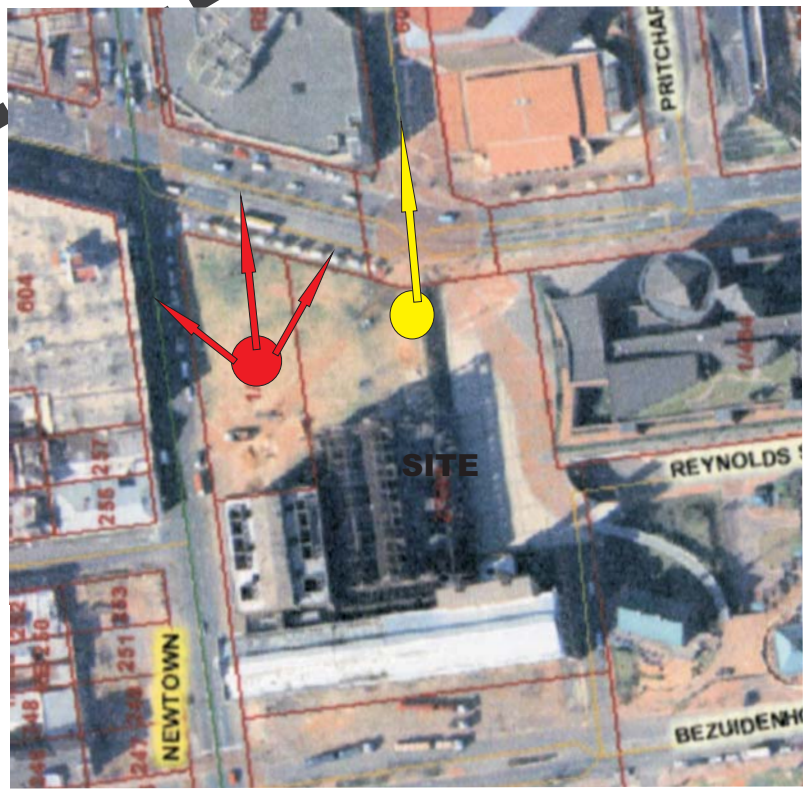


Fig 87. Location of viewpoints.

Views.

Fig 88. View up into Kerk Street.

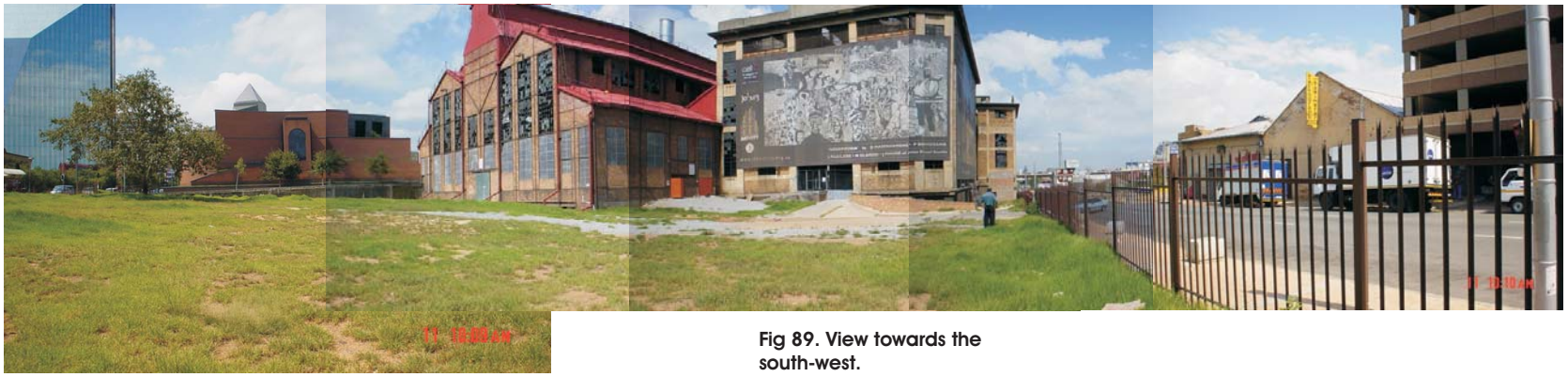


Fig 89. View towards the south-west.

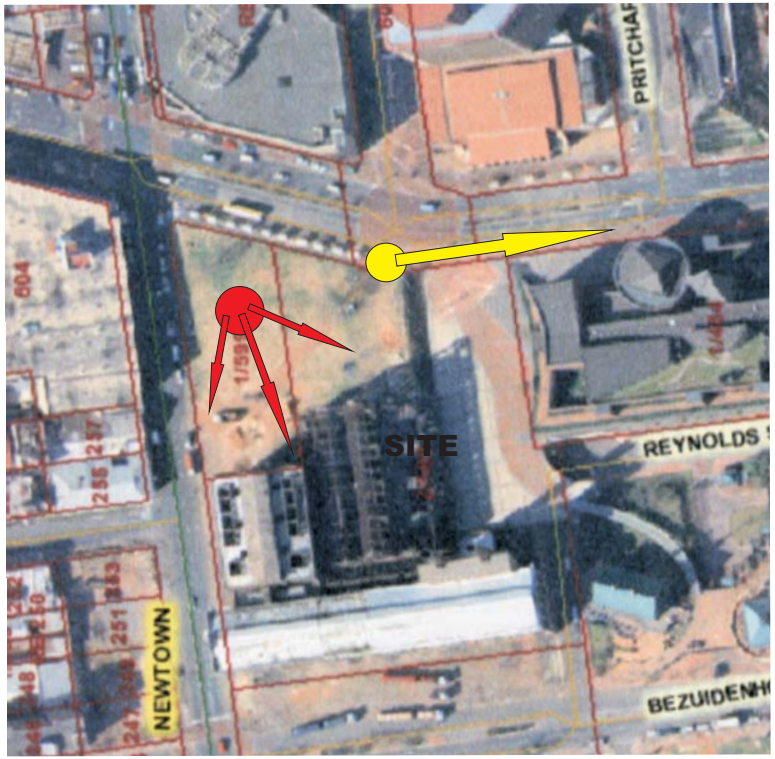


Fig 90. Location of viewpoints.

Fig 91. View south into West Street.

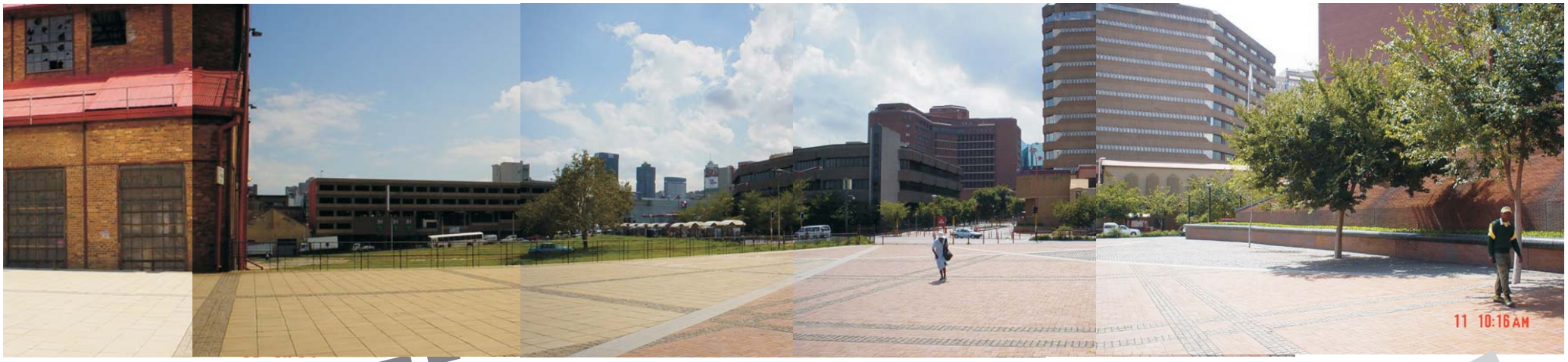


Fig 92. View to east across plaza.

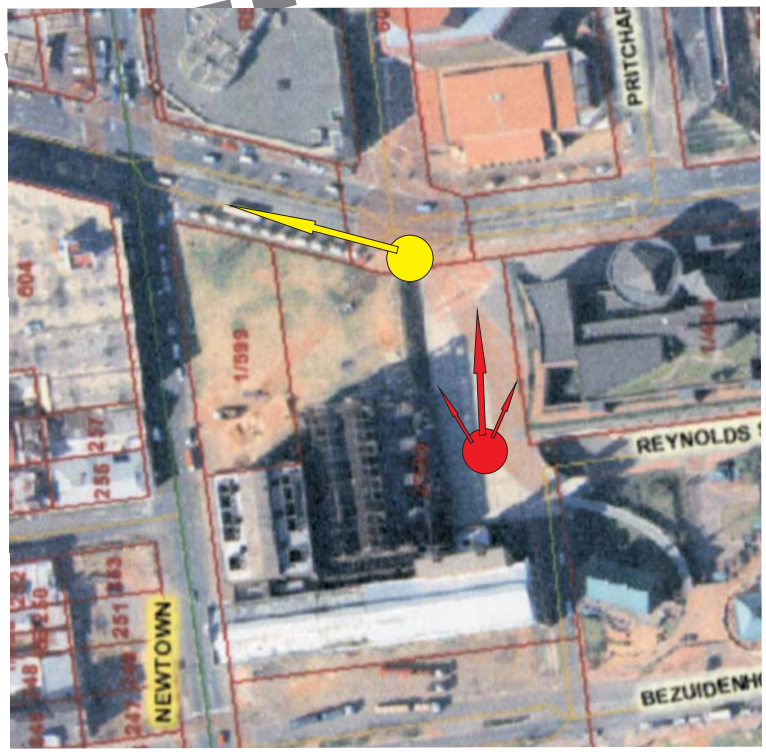


Fig 93. Location of viewpoints.

Fig 94. View to north-east up in West Street.

Fig 95. View to west across plaza.

Fig 96. Location of viewpoint.

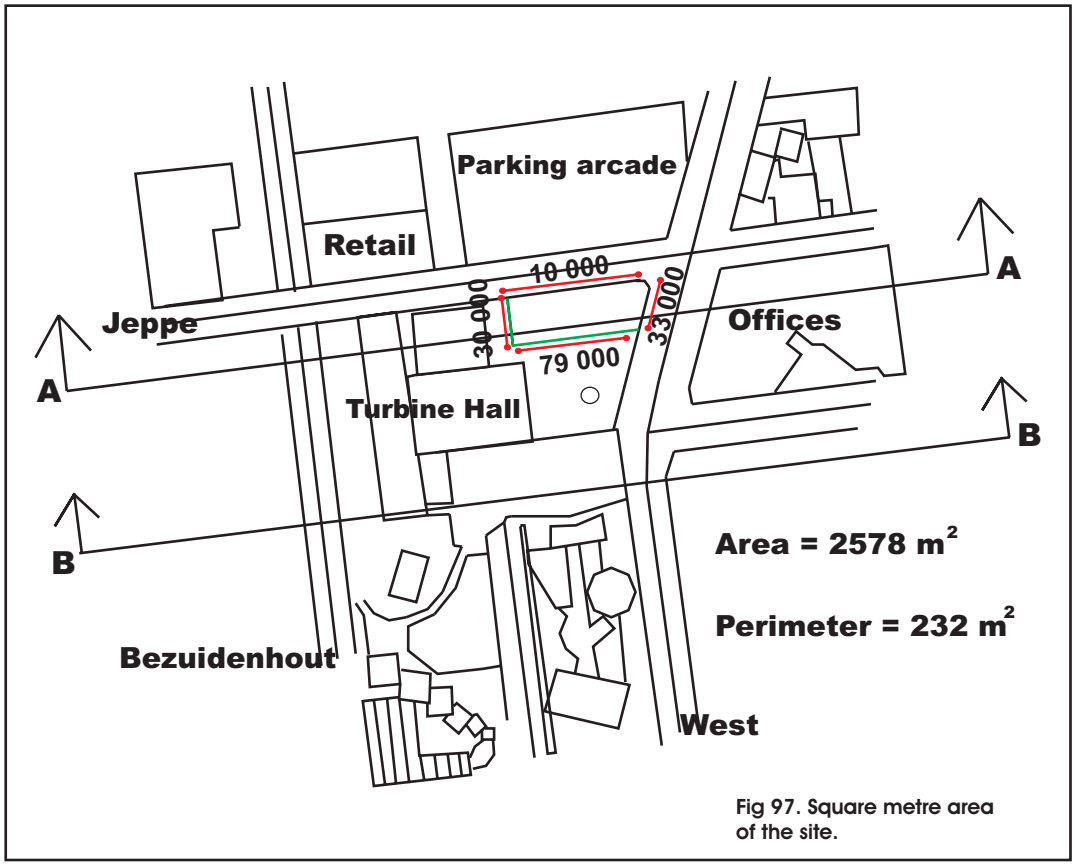


Fig 97. Square metre area of the site.

Fig 98. Site falls with slope of 1.8° towards the west.

Topography

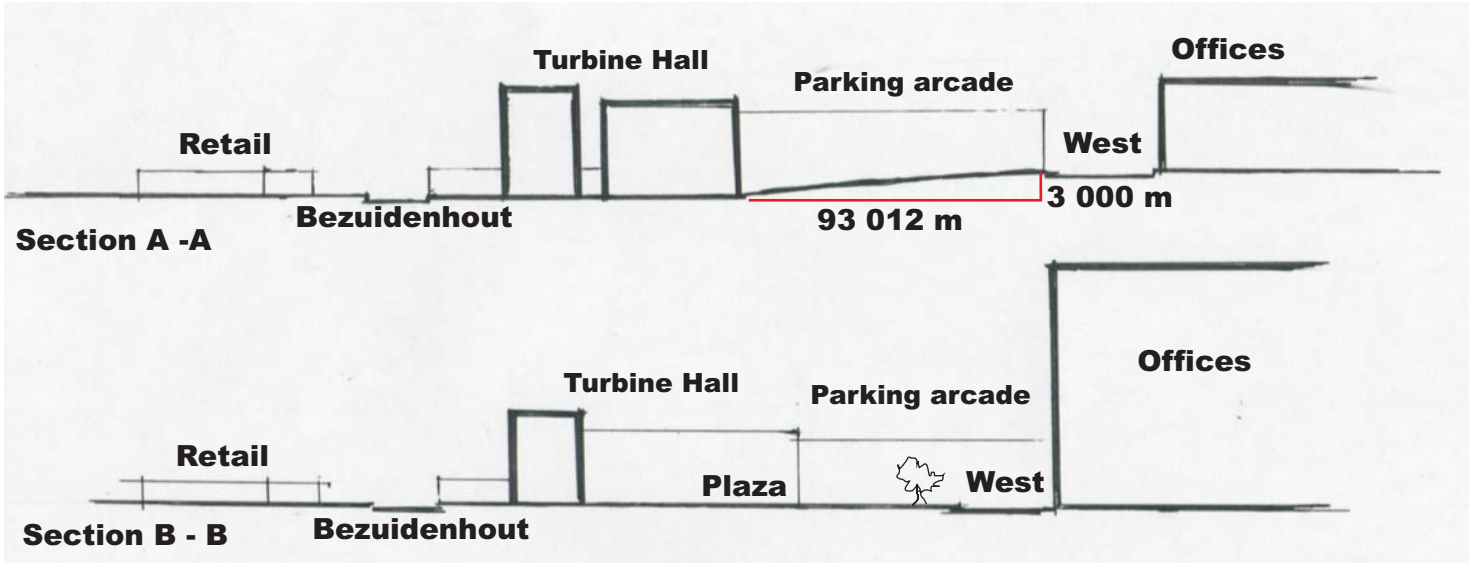


Fig 99. Site sections.

Month	Temperature (° C)				Precipitation		
	Highest Recorded	Average Daily Maximum	Average Daily Minimum	Lowest Recorded	Average Monthly (mm)	Average Number of days with >= 1mm	Highest 24 Hour Rainfall (mm)
January	35	26	15	7	125	16	188
February	34	25	14	6	90	11	56
March	32	24	13	2	91	12	92
April	29	21	10	1	54	9	50
May	26	19	7	-3	13	3	70
June	23	16	4	-8	9	2	31
July	24	17	4	-5	4	1	17
August	26	19	6	-5	6	2	21
September	31	23	9	-3	27	4	62
October	32	24	11	0	72	10	110
November	33	24	13	2	117	15	65
December	32	25	14	4	105	15	102

Fig 100. Statistics on temperatures and rainfall in Johannesburg, 2002.

Macro-climate:
Johannesburg's position: 26 08' S 28 14' E
Height: 1694 m

• Rain:
The average annual rainfall that mainly occurs due to thunderstorms during the summer rainfall season varies between 125 to 375 mm. The rain season occurs November to March, with the peak in January. 50 - 80 Rainy days may be expected. Hail is not uncommon. Winter rainfall varies from 62 to 250 mm.

• Temperature:
Summers are warm to hot, with fairly dry air, relieved by the thunderstorms. Winter days are pleasantly sunny with clear cold to very cold nights. The average daily maximum temperature vary from 26°C in January to 17°C in July, with extremes of 35°C and 24°C respectively. Average daily minimums range from 15 C in January to 4 C in July, with extremes of 7 C and -8 C respectively. [Average climate statistics for Johannesburg]

• Winds:
Prevailing winds are light to moderate and from the north-east direction in summer and from the north-east to north-west direction in winter. The strongest winds occur mainly in spring. Autumn and early winter seem to be the seasons with the lest wind. (Napier, 2000:9.8)

• Sunshine:
The duration of bright sunshine exceeds 80% in the winter and 60% in the summer. % Sunshine has a major influence on how buildings [illegible] regarding comfortability. (Napier, 2000:9.8)

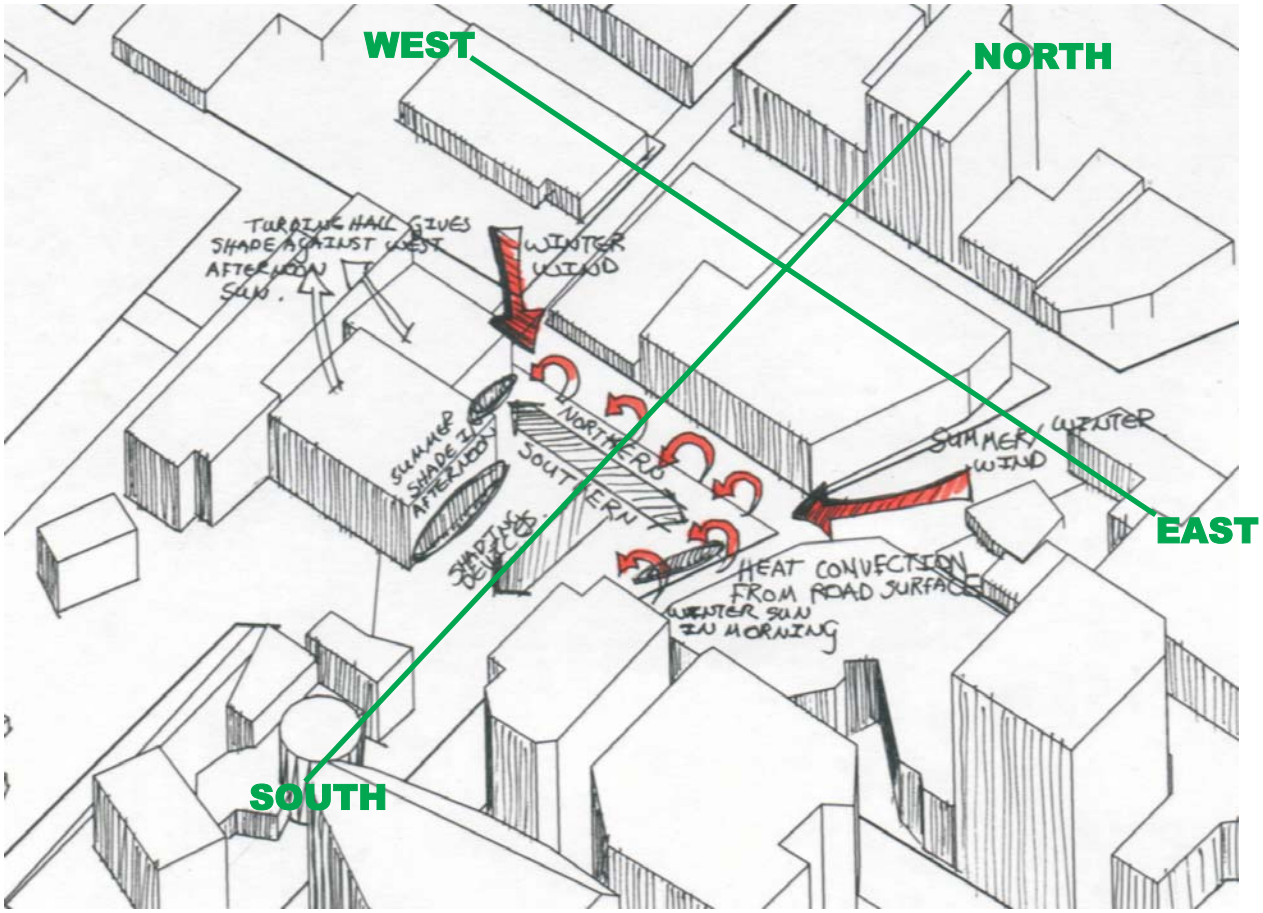


Fig. 101. Site climate.

• Surface temperature:
The most excessive temperatures for Johannesburg reach a maximum and minimum of 35 C and -8 C. These temperatures affects surface temperatures. A surface with a white finish reflects the most heat and has a lower surface temperature. A black surface absorbs the most heat and has the highest surface temperature.

• Relative humidity:
Johannesburg has a relative humidity of 30 - 50 % (Napier, 2000:9.8) Humidity has a major effect on personal comfort. Warm air holds more moisture than cool air. Evaporation and humidity is the lowest during the winter (drier air) and highest during the summer.

Relative humidity is the ratio of water vapour in a given volume of air as a proportion to the maximum amount of water vapour that could be contained in the same volume of air at the same temperature. A high relative humidity reduces the rate of evaporation of perspiration from the skin, which is a cooling process, and which prevents loss of heat from the body and which results in an uncomfortable environment.. Relief may be provided by sufficient ventilation. (Napier, 2000:9.14)

Micro-climate:

• Solar radiation:
Solar radiation is the heat we experience from the sun on the skin. Radiant heat always travels in straight lines and may be reflected or refracted. A body with a reflective surface will absorb far less heat than one with a dark, dull one. Figures for mean solar radiation for Johannesburg ranges from 2000 to 2250 kWh/m /year.

When the sun's radiation passes through the earth's atmosphere its strength is reduced by cloud conditions and pollution. When rays meet the earth's surface at a low angle, they are spread proportionally over a wider area, and will have a lesser heating effect. Sun directly overhead will deliver the strongest radiation. It is important to consider surfaces of buildings that are exposed to the sun. The absorption and reflection of radiant heat from the sun is dependent on the nature and the colour of the surface, and the nature or composition of the material itself. (Napier, 2000:3.2)

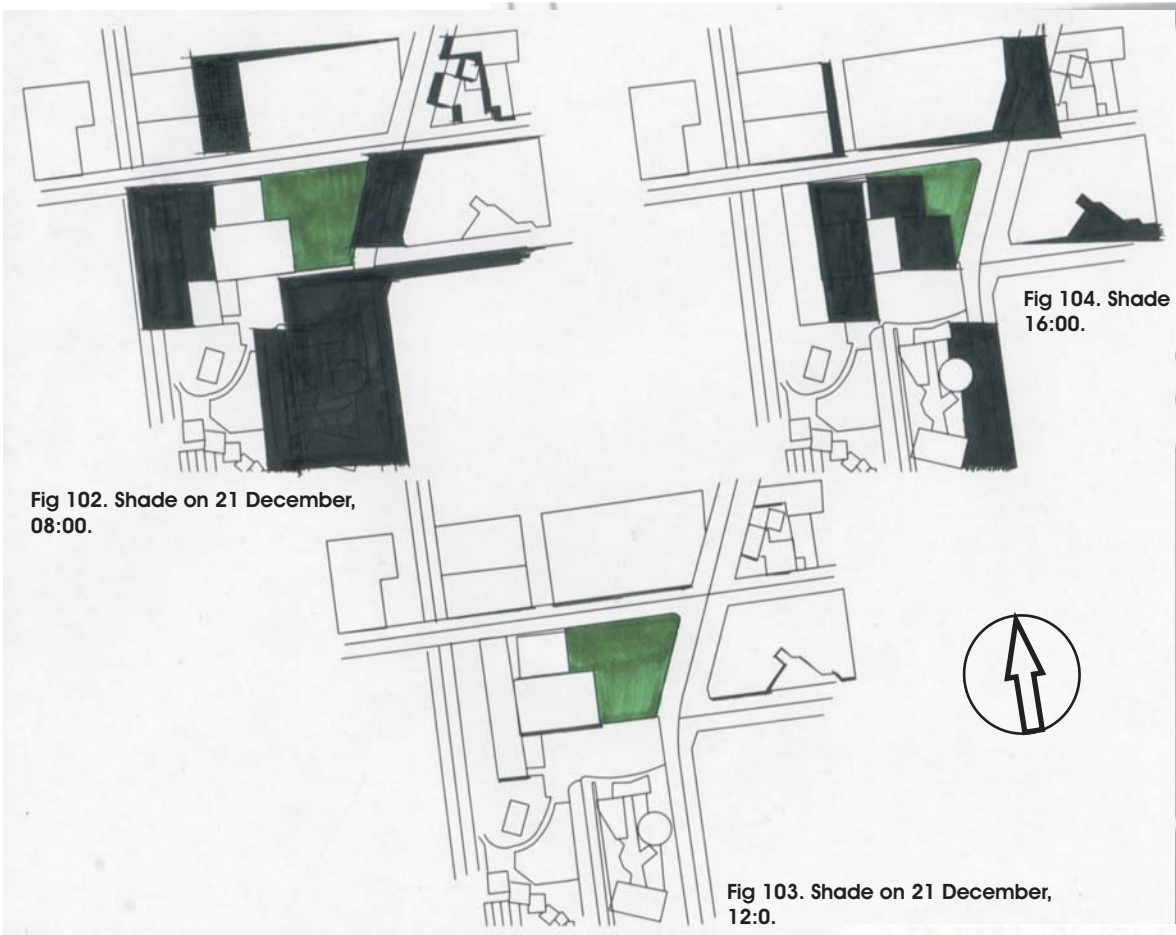
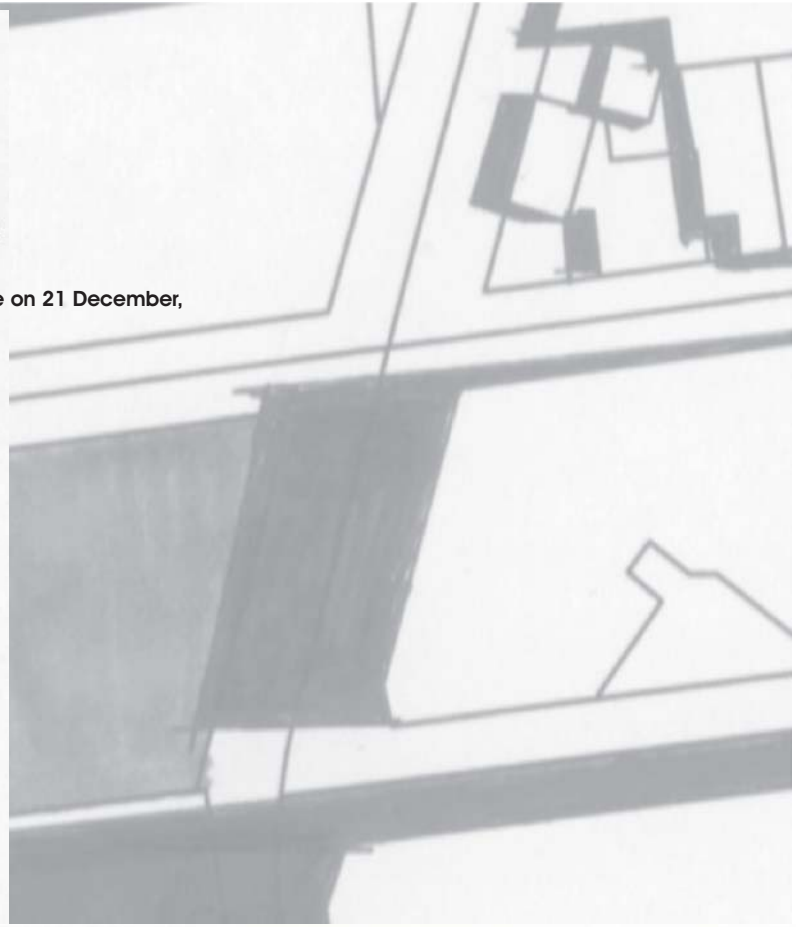


Fig 102. Shade on 21 December, 08:00.

Fig 103. Shade on 21 December, 12:0.

Fig 104. Shade on 21 December, 16:00.



JOHANNESBURG & PRETORIA Latitude (nearest) 26° South

Both cities taken as longitude 25.5°E (Add 4.5° or 18 minutes to solar time)

Solar times		*06.00*	*08.00*	*10.00*	*12.00*	*14.00*	*16.00*	*18.00*
Clock times		06.18	08.18	10.18	12.18	14.18	16.18	18.18
Azimuth	21/12	112E	101E	91E	0	91W	101W	112W
Altitude	21/12	10	35	63	88	63	35	10
Azimuth	21/3 & 9	90E	76E	53E	0	53W	76W	90W
Altitude	21/3 & 9	0	26	51	65	51	26	0
Azimuth	21/6	-	55E	34E	0	34W	55W	-
Altitude	21/6	-	14	32	40	32	14	-

Fig 105. Solar times, azimuth and altitudes of Johannesburg..

Sun angles and shading.

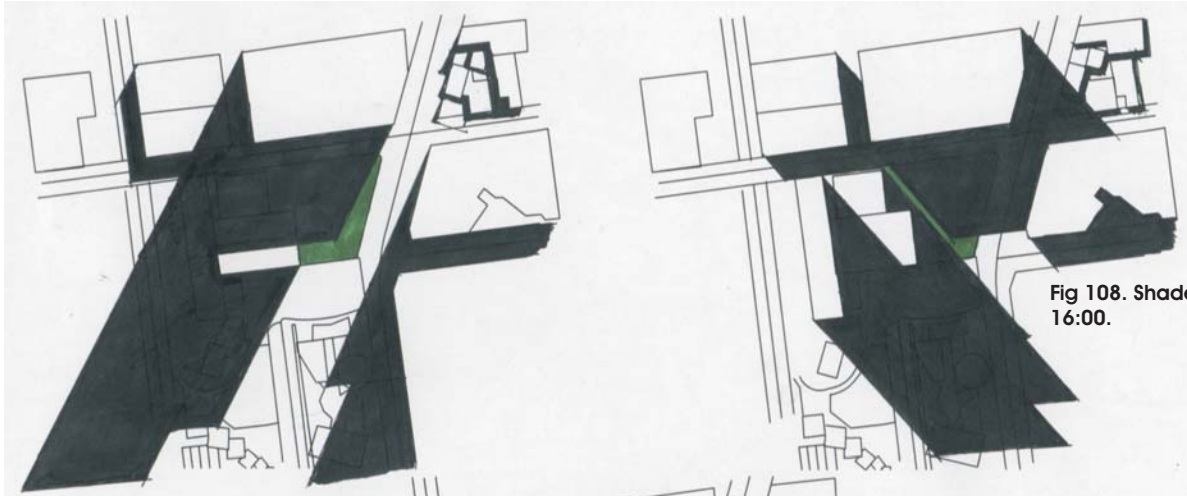
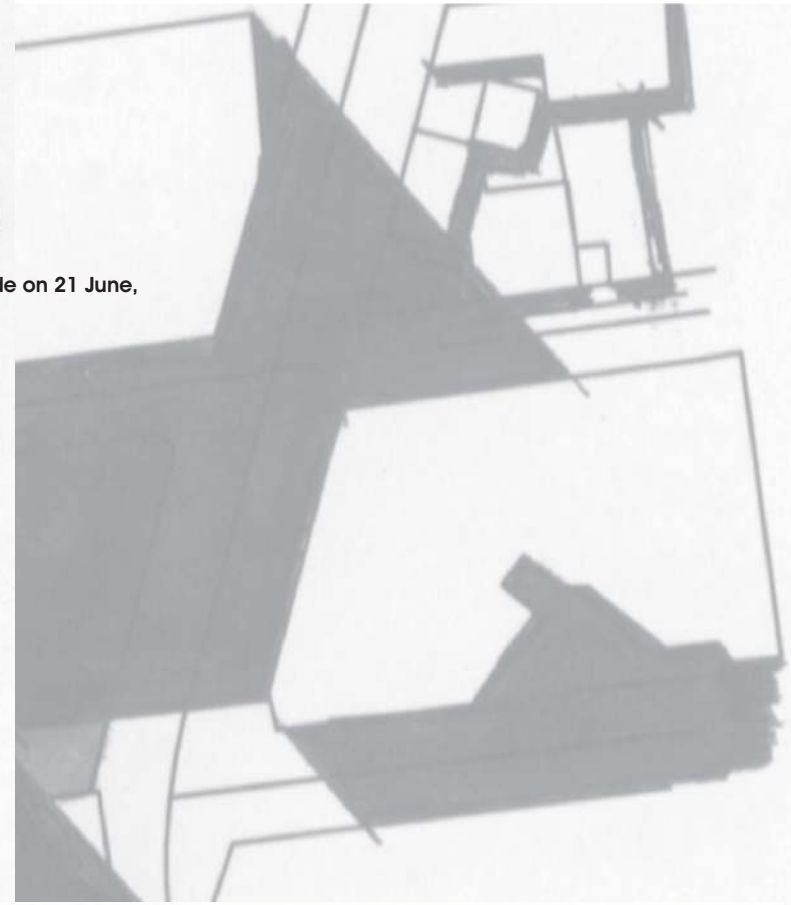


Fig 106. Shade on 21 June, 08:00.

Fig 108. Shade on 21 June, 16:00.

Fig 107. Shade on 21 June, 12:00.



JOHANNESBURG & PRETORIA Latitude (nearest) 26° South

Both cities taken as longitude 25.5°E (Add 4.5° or 18 minutes to solar time)

Solar times		*06.00*	*08.00*	*10.00*	*12.00*	*14.00*	*16.00*	*18.00*
Clock times		06.18	08.18	10.18	12.18	14.18	16.18	18.18
Azimuth	21/12	112E	101E	91E	0	91W	101W	112W
Altitude	21/12	10	35	63	88	63	35	10
Azimuth	21/3 & 9	90E	76E	53E	0	53W	76W	90W
Altitude	21/3 & 9	0	26	51	65	51	26	0
Azimuth	21/6	-	55E	34E	0	34W	55W	-
Altitude	21/6	-	14	32	40	32	14	-

Fig 109. Solar times, azimuth and altitudes of Johannesburg.

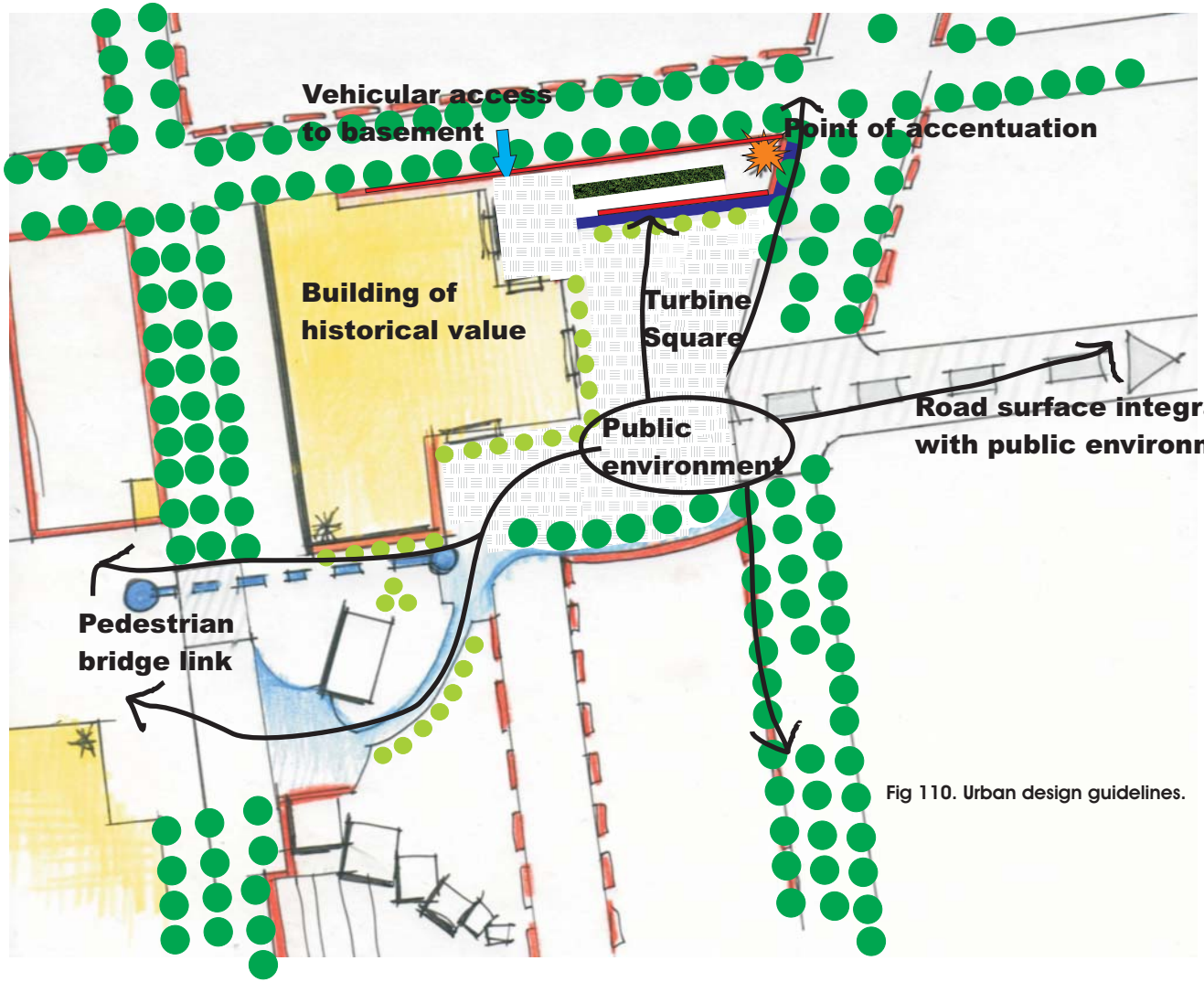


Fig 110. Urban design guidelines.

Mandatory build to line
Desirable build to line
Mandatory colonnades
Boulevard treatment
Tree lined paths

Site Development Parameters:

- Site area: 2578 m
- Coverage: 70%
- Building footprint: 1804 m
- Minimum of 2 storeys and maximum of for storeys.
- The envelope of development sees a maximum of 4110.4 metres square of the development or floor area ratio of 2.8 or a n average of 3609 metres square (2 storeys)
- Parking requirements:
  Retail = 4/100m
  Entertainment = 2/100m
  Residential = 1/10m
  Parking ratio of 2.3 bays/100m
  Parking: 83 parking bays maximum.
- Landscaped and paved areas: 440m

Urban Design Guidelines:

These following guidelines are aimed at creating a cohesive character for the area that builds on the existing and provides opportunity for the creation of active street levels that make pedestrians feel comfortable and safe. Developments are required to define the public space by establishing a facade line of the buildings directly along the boundaries of the public space.

The developments are required to be of a courtyard nature with and active public edge externally on ground floor level) and an internal private world. Vehicular access are limited to as little penetration of the public space as possible. This arrangement of access ensures the pedestrian priority in the public space.

There will be fixed facade lines abutting the street edges and public space. These edges must not to be impermeable and hard, but must define space. The creation of linked public spaces are important. A small square is proposed in front of the Turbine Hall next to Jeppe to create an open space for people when huge functions are held in the Hall. This space flows over into the Turbine Square. Architectural accentuation is necessary on the corner of Jeppe and West. Vehicular access ti possible basement from Jeppe. Pedestrian access from Turbine Square into building and through lifts from basement.

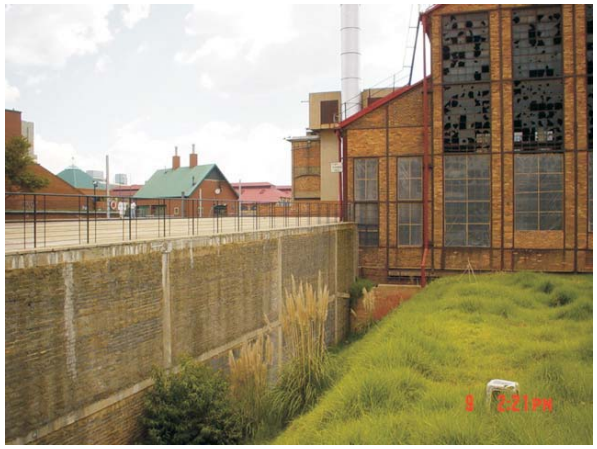


Fig 111. Pedestrian barrier.

Movement

Movement around the site is mainly car, bus and taxi orientated. Pedestrian circulation occurs along West street where the informal trading are and across the plaza to Bezuidenhout Street. A ditch prevents pedestrians to cross from the plaza to the site. This barrier will be removed in the construction of the Turbine Square. There is no access up into Kerk Street. The Kerk Street Mall is proposed for the future.

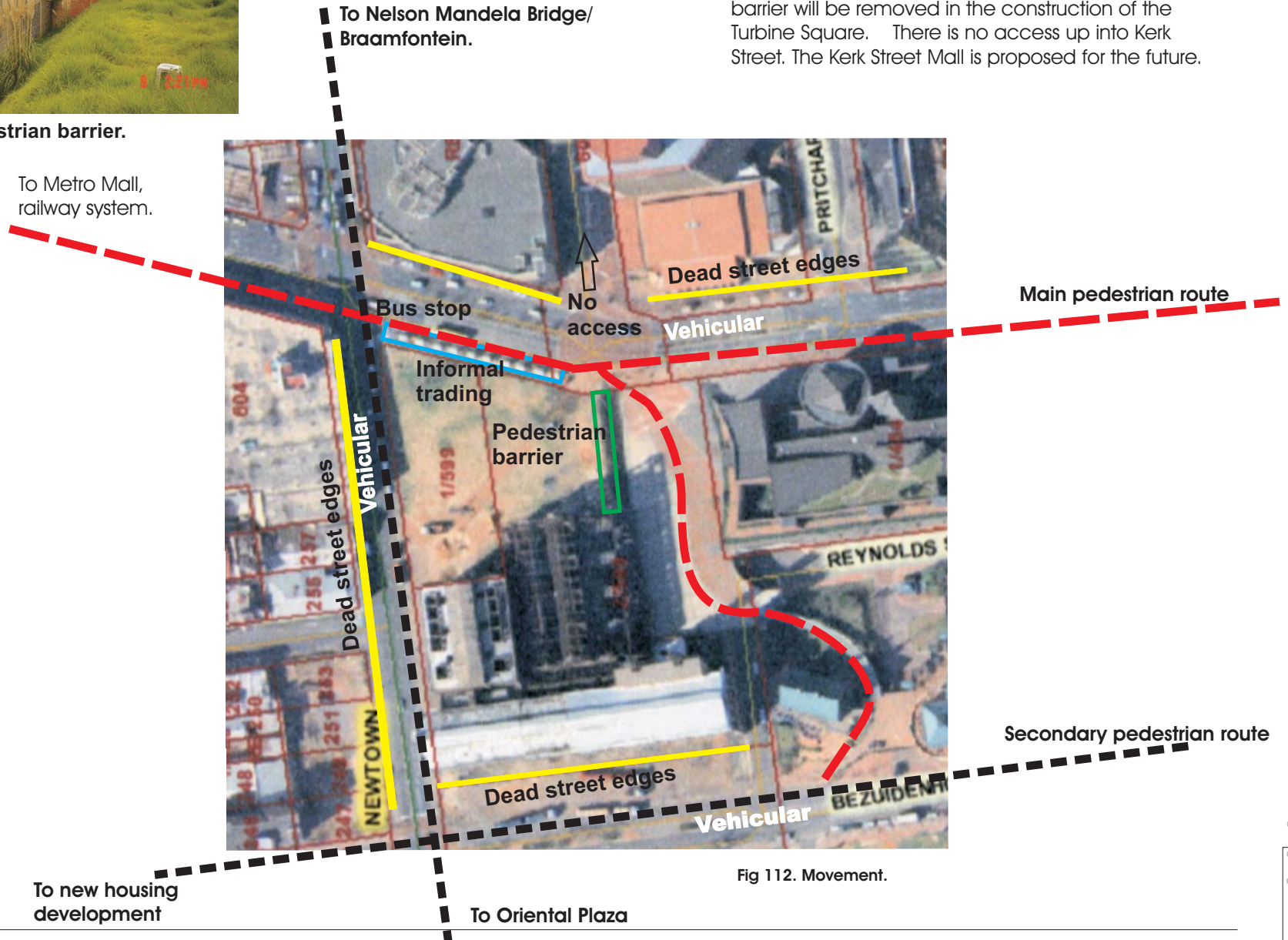


Fig 112. Movement.

Cato Manor Development Project, Durban, 1994.

This project is a model for successful inner-city redevelopment. Cato Manor was an area that suffered greatly during the post-apartheid era in South Africa. The development involves the need to redress the injustices of the past and promote black empowerment. The success of the project as result of a high level of community involvement.

The project consists of the provision of a full range of facilities like trading spaces, low-cost housing, schools, libraries, multi-functional community halls, roads and clinics. The focus is placed on economic development and community empowerment through training programmes as well as small, micro and medium enterprise development.

Applicable concepts:
- A community led initiative.
- The project establishes technologies, systems, procedures, institutional and human resources which can be applied to other urban infill and restructuring projects elsewhere in the country.
- The creation of a vibrant and self-sustaining entrepreneurial framework that will lead to further economic and employment opportunities.

Fig 113. The Cato Manor development

Fig 114. Participants in a course for emerging entrepreneurs.

Fig 115. Cato Manor

Fig 116. The Cato Manor development

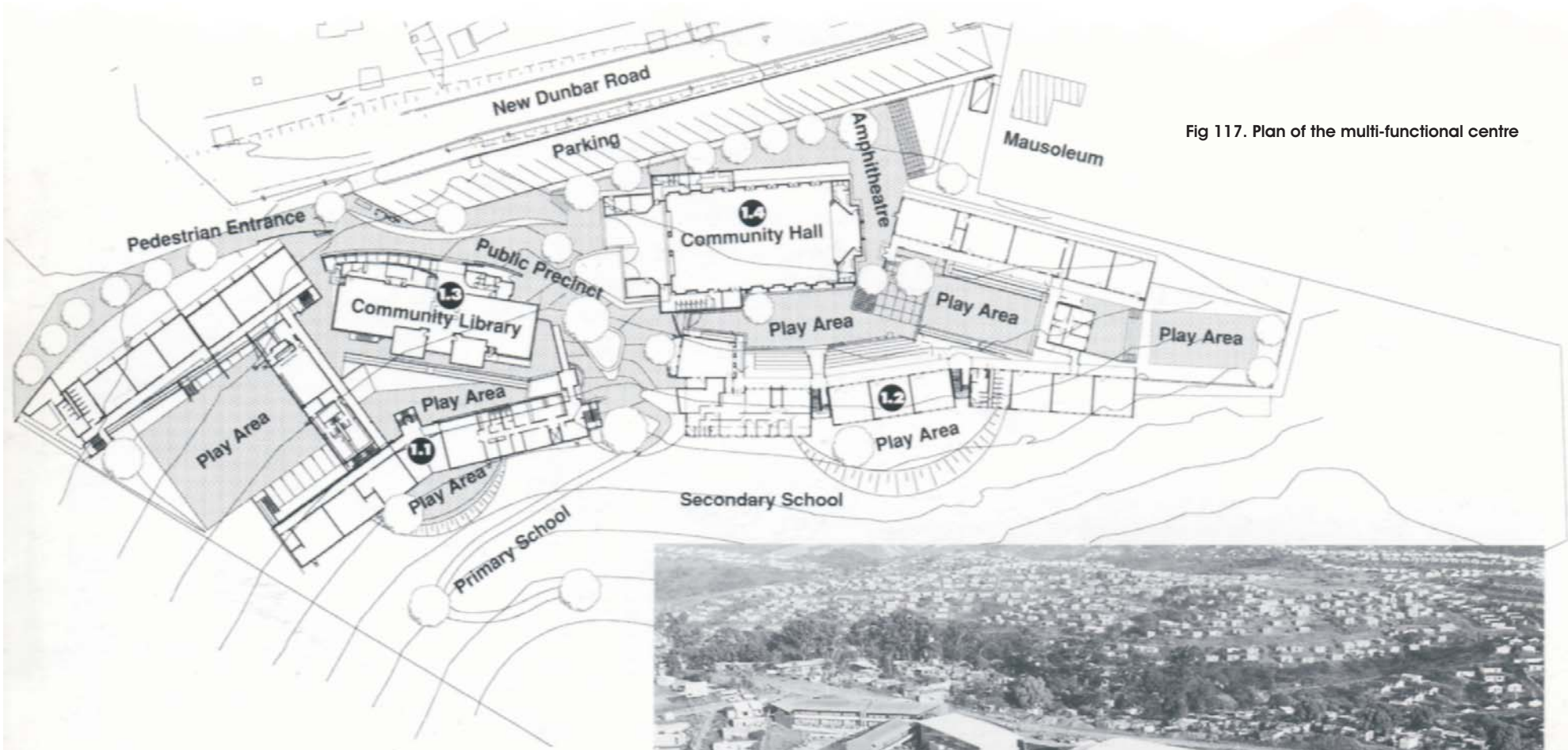


Fig 117. Plan of the multi-functional centre

Fig 118. Section through the multi-functional centre

Fig 119. Public buildings: the Wiggins-Umkhumbane Multi-purpose Centre

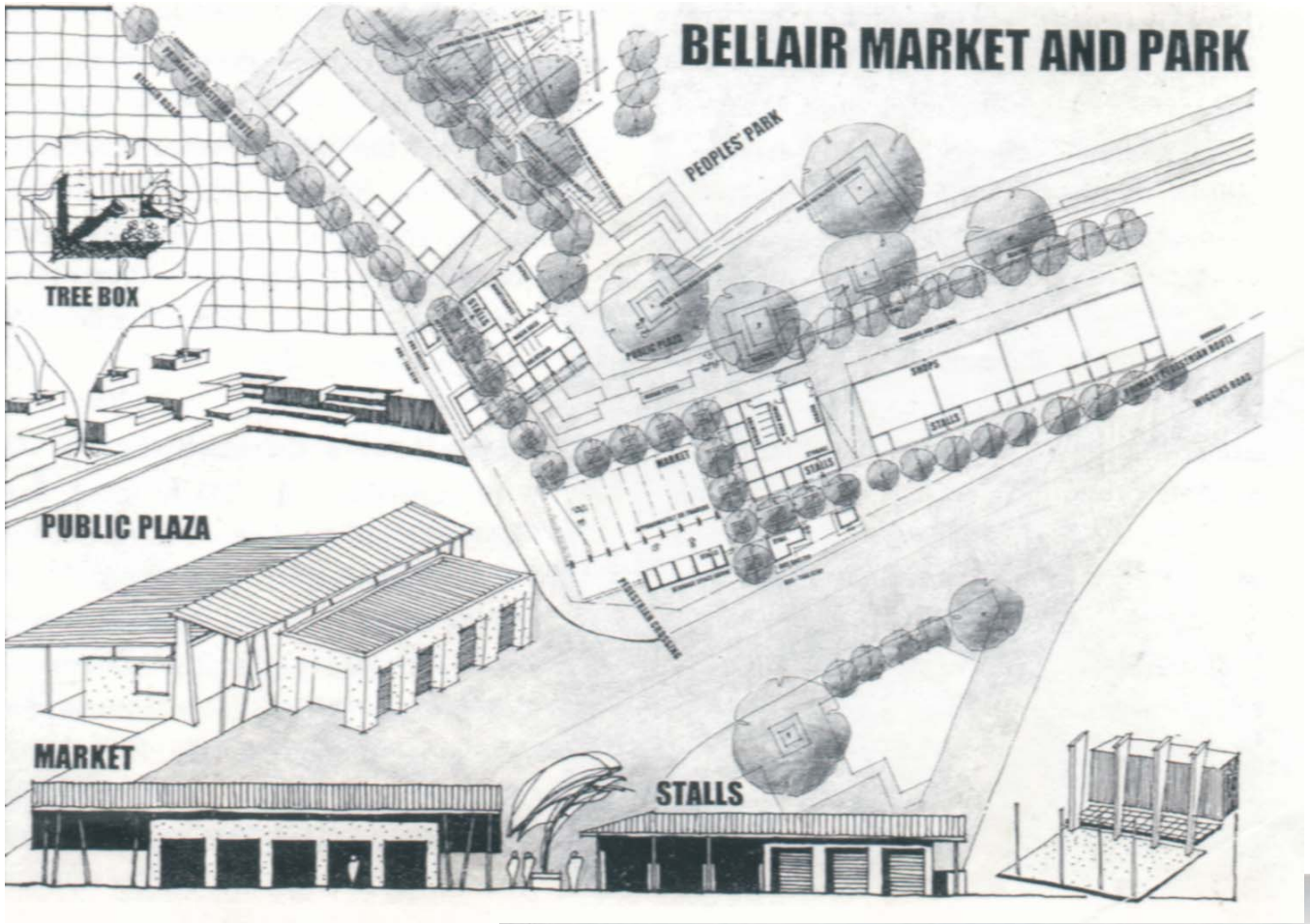


Fig 120. The Bellair Market and Urban Park

Fig 121. The Bellair Market

Fig 122. Public building: the Bellair Centre

Fig 123. The school has outside teaching spaces provided with seating and a chalkboard wall

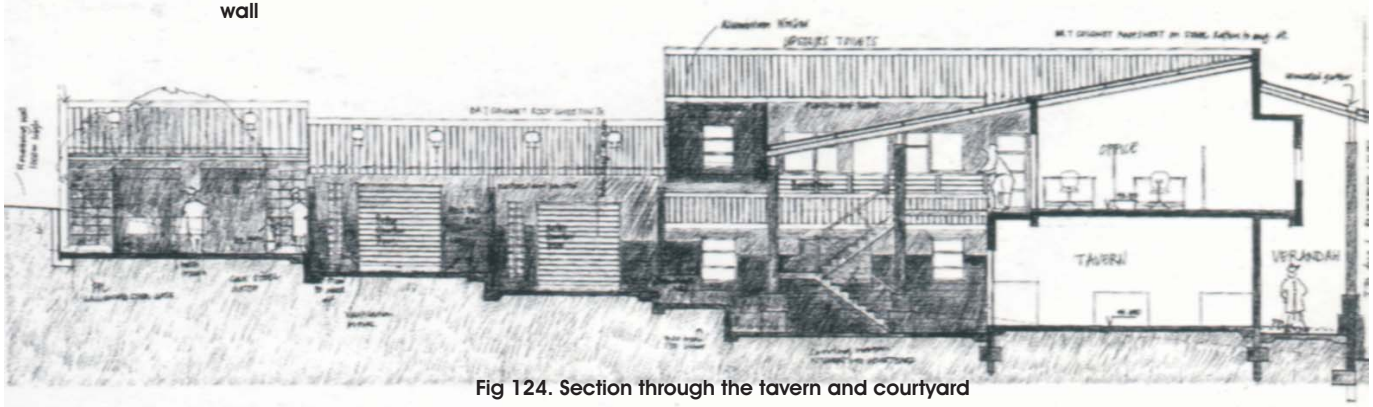


Fig 124. Section through the tavern and courtyard

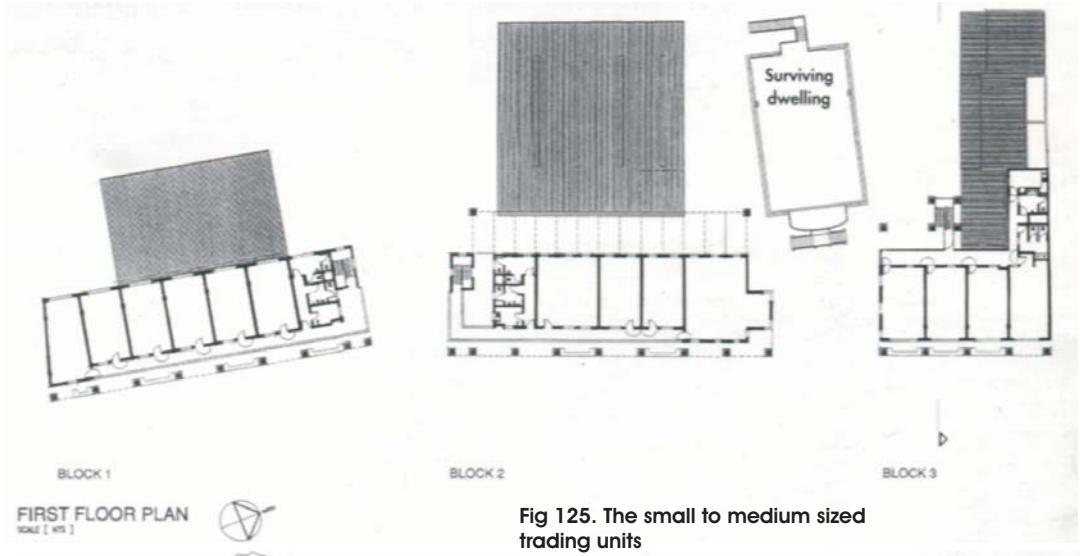


Fig 125. The small to medium sized trading units

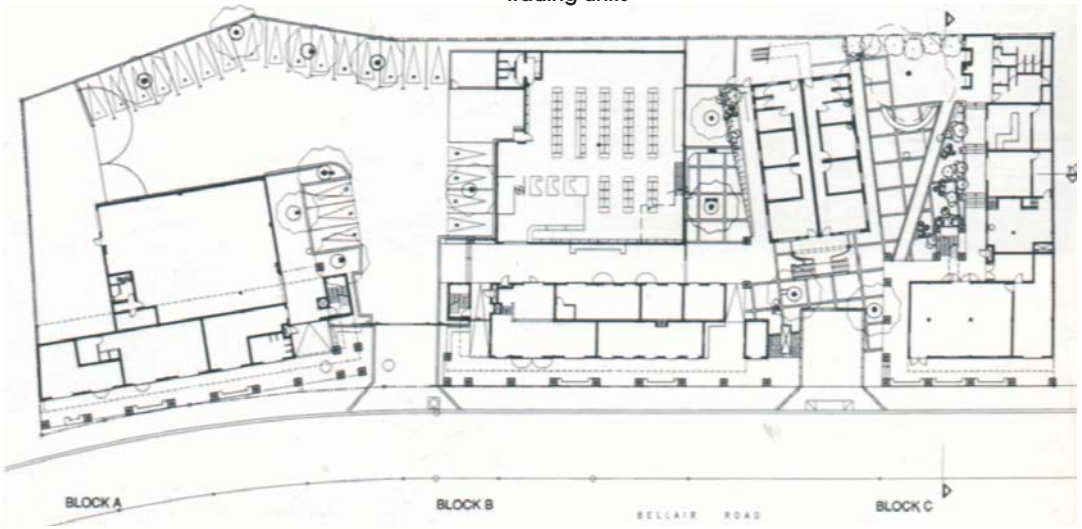


Fig 126. Ground floor plan of the Bellair Centre

Fig 128. Section of the housing units

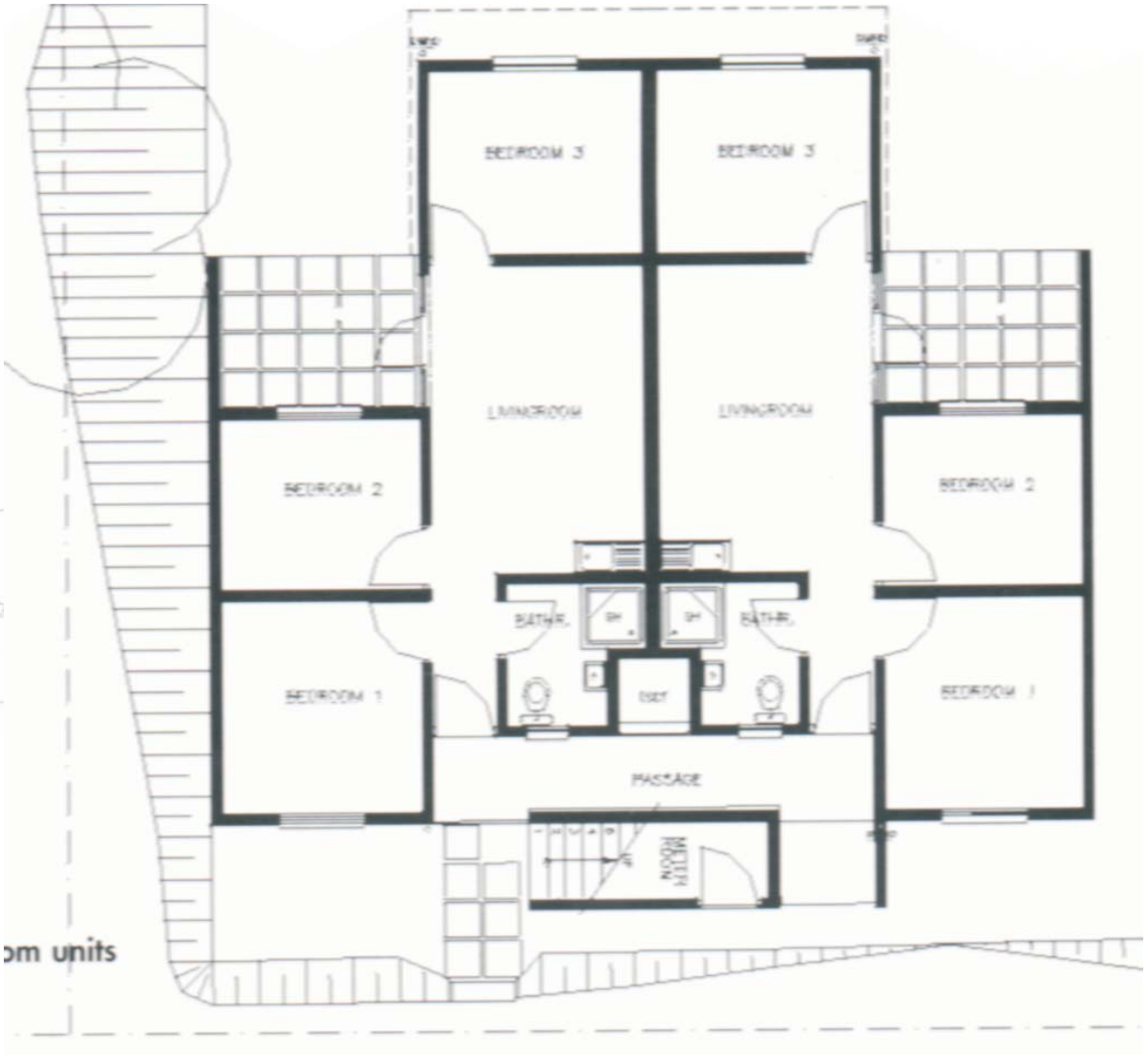


Fig 127. Plan of the housing units

Fig 129. Social housing in Shayamoya Road

The Dance Factory: Newtown, Johannesburg.

The Dance Factory is situated in an old warehouse building that was renovated to create highly versatile spaces for informal dance programmes and performances. Suzette le Sueur is currently the director of the space. The Dance Factory solely rely on donations from institutions and from payments from letting out the spaces in the building. Various dance classes are presented for all ages, ranging from 7 year olds to adults. These classes are free.

Newtown is seen as the hub of cultural activity in Johannesburg. Recently the Dance Factory became much sought after by dance and music performers, who hire the spaces for performances. The demand is so huge that conflicts arise between dancers and musicians. Plans for extra studios and dressing rooms are planned for the future when the necessary funding is available.

The performance space consists of a collapsable steel framework of seats with cushions. The stage is a wood-sprung floor covered with non-slip material. The scenery are minimal and consists of a variety of a white background, black bacground and a brick wall kept from the original warehouse building. This brick wall as scenery creates an amazing effect with lighting. A naturally lit corridor gives access to the dressing rooms.

The spacious studio is a versatile space flooded with light. Overseas dance companies who visit the Dance Factory are amazed at the luxury of the spaciousness of the studio, especially its ceiling height: dancers feel inhibited and restricted by confined spaces.

A colourful interior decorates the entrance foyer. Offices are situated on a mezzanine level above the entrance foyer.

Fig 130. The Dance Factory


Fig 131. Informal seating


Fig 132. Colourful entrance to the building.

Fig 133. Dressing rooms.

Fig 134. The stage area.

Fig 135. Renovation of the old warehouse.

Fig 136. The spacious dance studio.

Fig 137. The brick wall functions as part of the scenery.

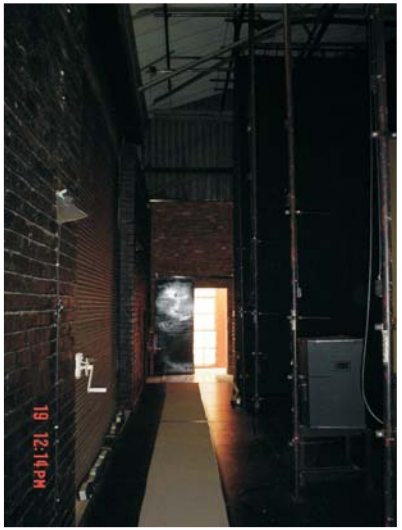


Fig 138. The backstage area.

Fig 139. The lighting bridges for stage lighting.

African Craft Market, Rosebank, Johannesburg. Architect: Kate Otten Architects. 2000.

This busy vibrant public market functions as a public shopping arcade. The design is pedestrian orientated because of the human scale of the internal pedestrian walkway. The public environment around the market is pedestrian-friendly and visitors circulate freely from the one end of the arcade to the other.

Internally a double volume is interrupted by a mezzanine floor to accommodate an open shop on the ground floor. The pedestrian spine on the ground floor is visible from the open shops on the first floor. Light penetrates through the penetrable roof into the double volume and crates a feeling of lightness and well-being. Services, like the shiny bold air conditioning ducts, adds to the feeling of openness and honesty and reflects the light filtered through the roof.

The strip of windows just below the concrete slab of the first floor give the building a sense of weightlessness and its seems to float above the ground. There is a contrast in the solid, anchored parts of the building and the light delicate detail of the balustrades.

A visual rhythm is created throughout the building. The same wavy pattern is repeated in several elements of the building that suggests an organic, flowing movement. This pattern can be seen in the solid wall and the lightweight glass that

Fig 140. Stairs leading to shops on first floor and balustade with flowing pattern.

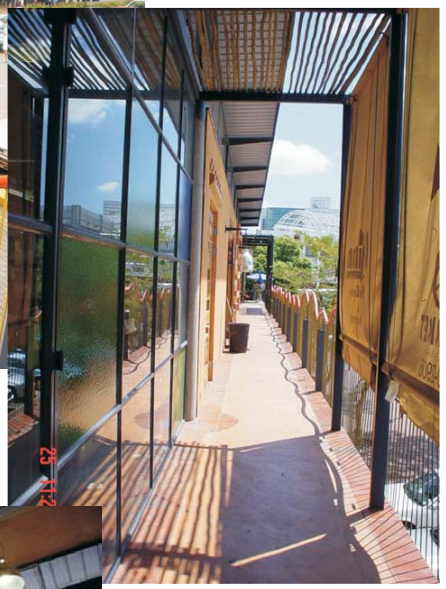


Fig 143. Access to shops on first floor.

Fig 141. Exposed air conditioning services.

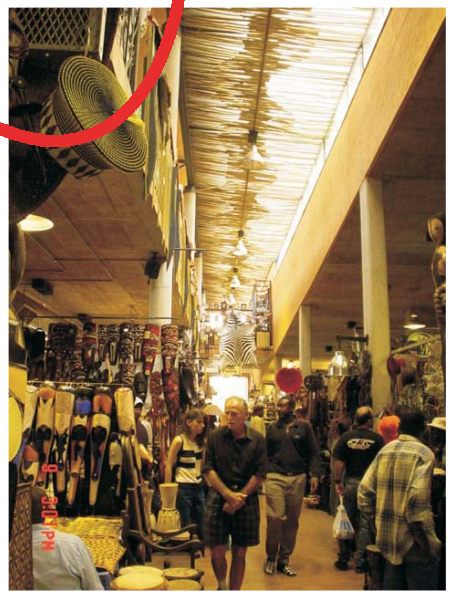


Fig 144. Internal pedestrian arcade.

Fig 142. Visual rhythm of wall and class.

The Kuppersmuhle, Duisburg, Germany; Architect: Hertzog and De Meuron, Switzerland.

'As the industrial relics are gradually reclaimed for new use, the heart of the city grows strong.' [Richters, 1999:68]

The Kuppersmuhle, an industrial relic in Duisburg's harbour area, has been inventively transformed to house a major collection of German art.

The warehouse is the most historically significant structure in Duisburg's inner harbour. The brick warehouse was built between 1908 and 1916 by the Keifer Brothers and Joseph Weiss. The warehouse has a strong monumental quality, reinforced by its heroic scale and robust materiality. The area is currently being rejuvenated to a masterplan by Norman Foster. The masterplan involves finding new uses for old industrial buildings such as the Kuppersmuhle.

Most of the warehouse's load-bearing structure could be fruitfully incorporated into the building's renovation. Three floors of exhibition spaces are linked by a new stair tower, placed to the rear of the main warehouse block. The new respects the old: the stark lines of the tower echo the Kuppersmuhle's muscular, industrial functionalism. Narrow strips of vertical glazing are incised into the tower's terracotta coloured concrete flanks. A stair case winds up to the galleries creating a vertical movement through the building. The warmth of the terracotta walls and the organic sensuousness of the stairs give the space a remarkable womb-like quality. The proportions of the stair treads are intended to slow down progress slightly so that visitors proceed through the building at a pace conducive to the contemplation of art.

Galleries are calm and introspective, with simple white walls and cool stone floors. Daylight is admitted through carefully positioned glazed strips which supplement levels of predominantly artificial illumination.

Hertzog and de Meuron's strategy of intervention and renewal seeks to respect both the building and its contents. The revived building makes a contribution to Duisburg's wider urban regeneration.

Applicable concepts:
• The regeneration and revival of a previously unused industrial area for cultural activities.
• The new respects the industrial feel of the old.

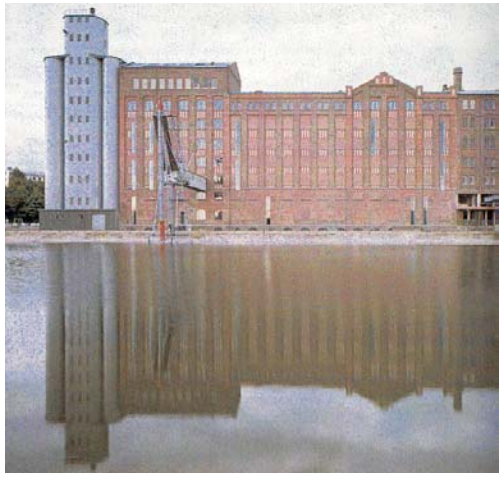


Fig 145. The Kuppersmuhle in the Duisburg harbour.

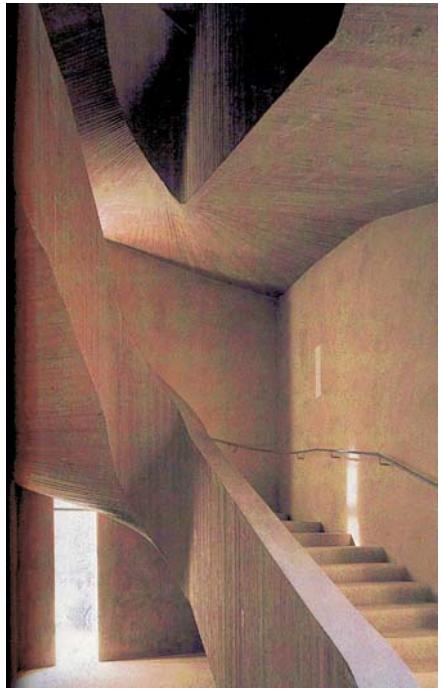


Fig 146. Interior of the new stair case.

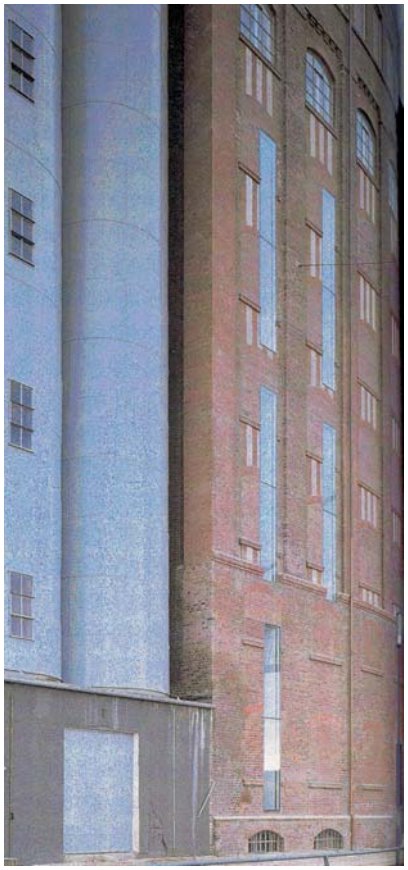


Fig 147. The imposing bulk of the Kuppersmuhle.

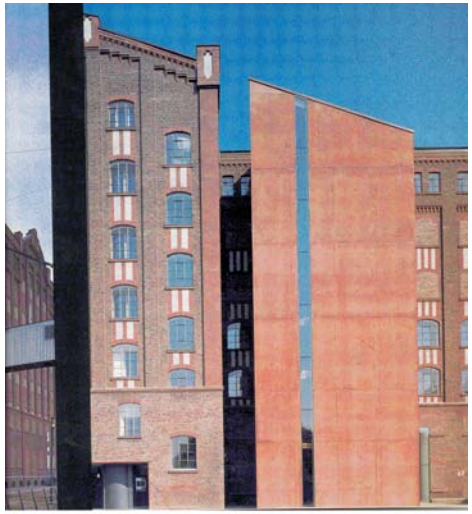


Fig 148. The new staircase from outside.

The Markant Theatre, Uden, Netherlands.
Architect: Herman Hertzberger.

'When you attend the theatre in Uden you are also on display on the town stage.'
[Ryan, 1999:55]

The Markant is a municipal facility welcoming drama, musicals, opera and rock concerts. The theatre is build near the towns amorphous Market Square. The theatre presents itself on a vertical Constructivist billboard, with an enormous tilted window which extends across the facade to illuminate a multi-storeyd foyer within.

The inevitable bulk of the flytower is placed where it is visually less obtrusive and can be easily serviced by vans. While the site's western edge has a gated lane for fire escape, more intimate spaces (rooms for performance artists, showers, lavatories and staff offices) are along the eastern perimeter. The director's office protrudes out above the street to lock the dynamic composition into place.

Colour plays an important role in Hertzberger's work. Secondary elements, like exposed staircases, swatches of gridded glazing, columns configured as pylons or trees, are also important features in the composition of the building.

The roof unites the public perception and experience of the architecture. The entrance is past a ticket kiosk. This is a continuation of the brick skin that lines one side of the billboard and wraps around the directors office with its horizontal slit window.

An ensamble of catwalks and open stairways - enclosed in clear glass and baby blue solid or perforated metal - emphasizes movement through the building. Propped by a row of X-shaped supports, the foyer's canopy is occasionally eroded by circles through which horizontal members are exposed.

Visitors enter on both sides of the auditorium slightly above street level and arrive into a sea of 688 coloured seats designed by the architect for a dynamic play of colours. Horizontal bands house speakers and zigzag forward for acoustic absorption. Ahead is the generously proportioned stage. The corridor linking the change rooms is illuminated by a continuous strip of glazing overlooking the foyer below.

Applicable concepts:
- Dynamic form and colour.
- Use of light and openness.
- Movement through spaces with the use of stairs, ramps and catwalks.

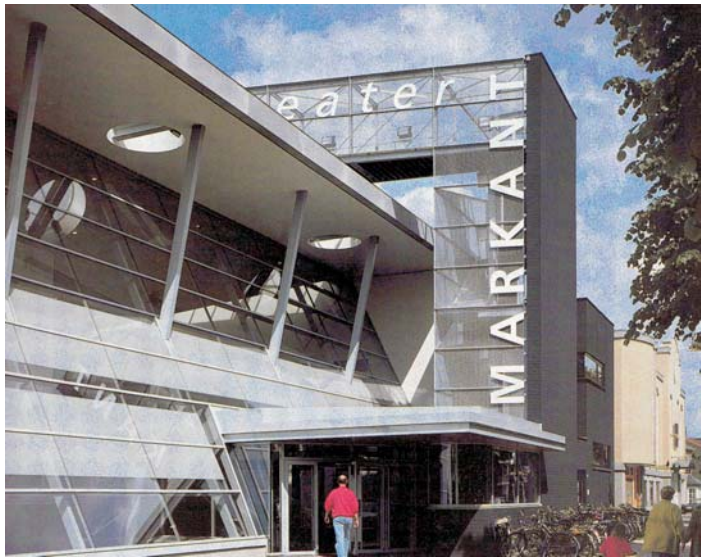


Fig 149. The entrance of the Markant Theatre with itrs signpost.

Fig 150. Light pours into the foyer through the huge sloping glass wall.

Fig 151. Entrance to the Markant Theatre.

Norwich on Main. Cape Town.
Architect: Stauch Vorster Architects.

'There is a tendency in South African cities to dress buildings in period costumes. The design team rejected these ideas and sought to create a building which is entirely informed by its context, appropriate technology and materials.' [Grundling, 1999:17]

The client brief for Norwich on Main included the provision of an A-grade office development comprising 14 000 square metres. The challenge was to create a building that could accommodate a variety of tenants of different sizes while still maintaining a typical building width of 12 metres to allow for penetration of natural light. The building orientation had to maximise the views to Table Mountain to the west and the panoramic view of the Hottentots Holland mountain range to the east.

Certain urban design issues were addressed in the development:
• Street interface: Main road forms a continuous thread of activity connecting one suburb to the next. This activity spine demanded a defining pedestrian-friendly edge to the street and created opportunity for thresholds between the public and private domain.
• Public place-making: this was addressed in the articulation of the street as a public place. The creation of a landscaped square reinforced the beginning of a more semi-public domain. Public freely penetrate the complex. This creates a neutral meeting ground which in itself creates further opportunities for mixed use.
• Surrounding urban fabric: there is a wide range of building types and functions in the area. Since there is no unifying scale on aesthetic evident within the immediate environment it was agreed to approach the project as a 'piece of the city' rather than a uniformly treated super block: the bulk of the building is fragmented into three separate components each responding to individual edge conditions.
• Exterior treatment: The facades of all three buildings are articulated to define the building's base, middle and top. This breaks the totality of the facade up into recognisable elements, giving coherence to the sculpting of the vertical plane. The colonnaded base provides a threshold between internal and external spaces creating a more human scale. Important corners are celebrated by glazing. The roof elements are made up of flying, lightweight, curved forms with deep overhangs. Other lightweight elements like angular steel and timber balconies contrast with the heavy structure. Materials and their assembly are used honestly. Junction between primary and secondary elements and different materials are carefully articulated to maintain integrity of each element.

Applicable concepts:
• The use of urban design principles to create a vibrant public environment that is pedestrian orientated and at a human scale.

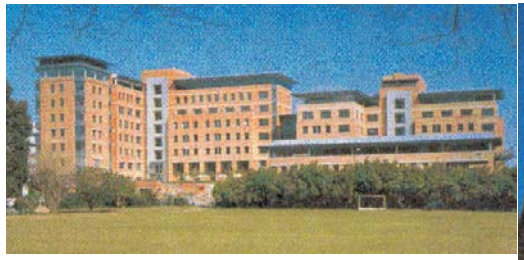


Fig 152. West elevation.

Fig 153. The corner is celebrated by the clip-on steel and timber balcony and stairs leading to a lower courtyard.

Fig 154. Articulation of the facade.

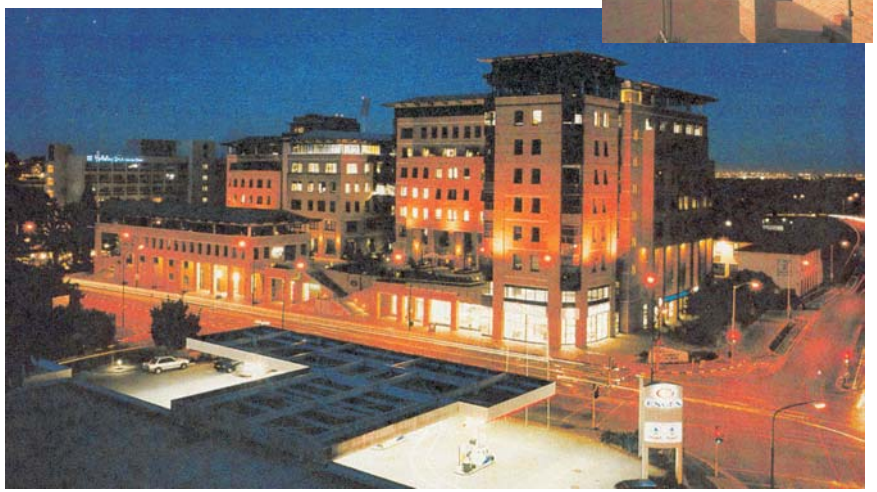


Fig 155. Night shot of the building.

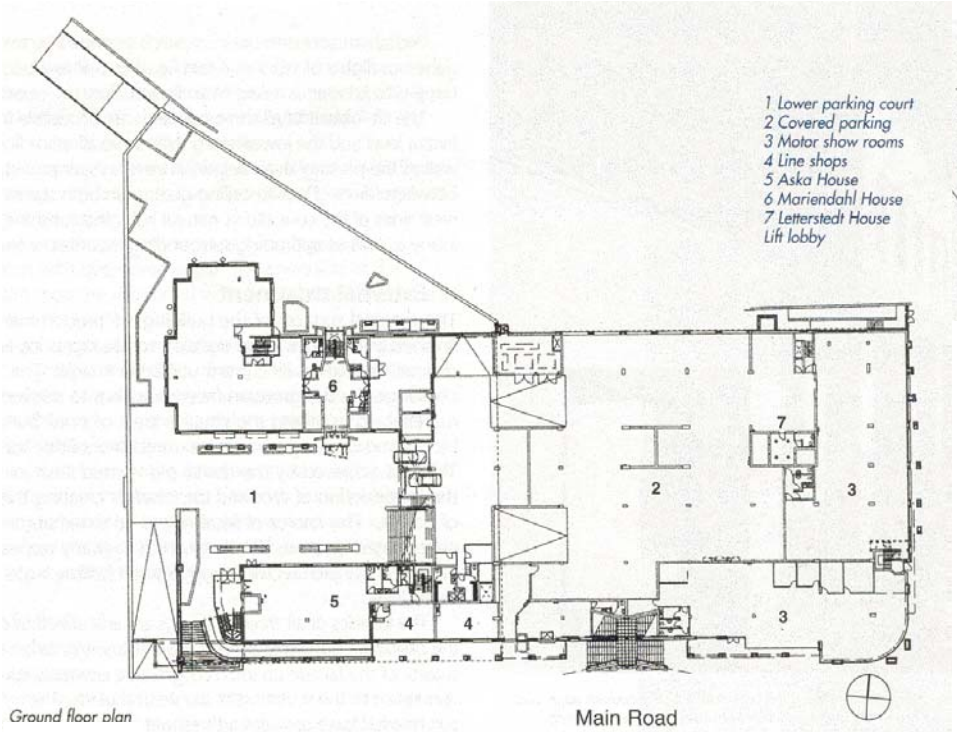


Fig 156. Norwhich: ground floor plan.

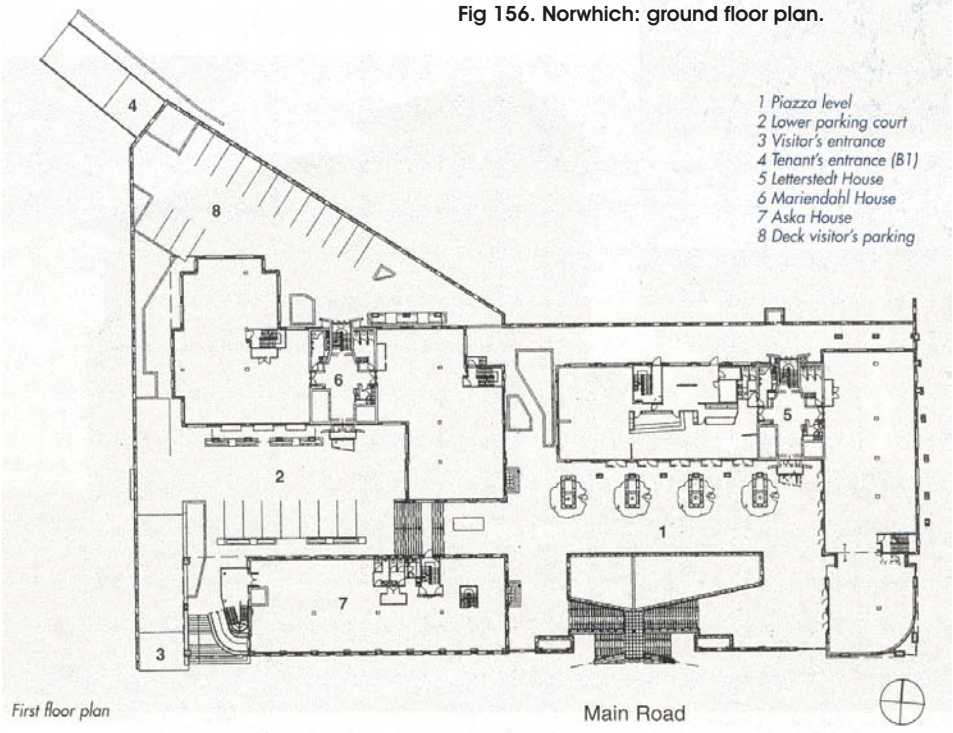


Fig 157. Norwich: first floor plan.

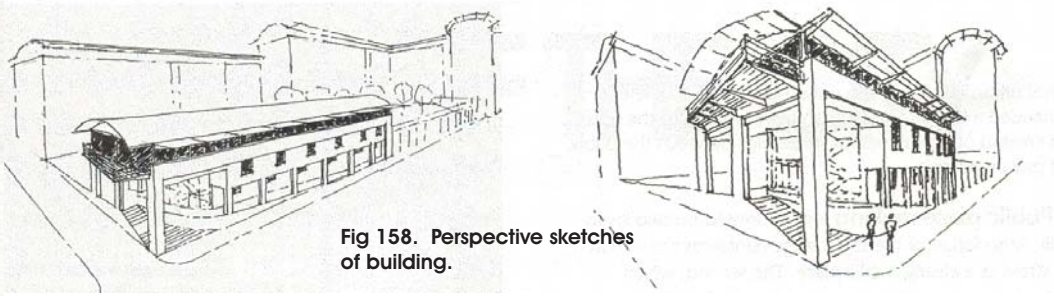


Fig 158. Perspective sketches of building.

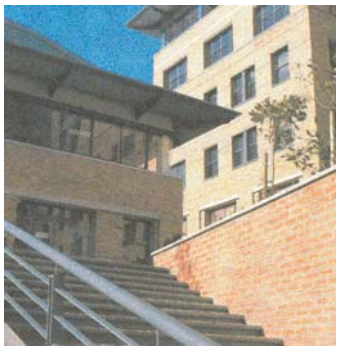


Fig 159. Stairs leading from Main road to courtyard.

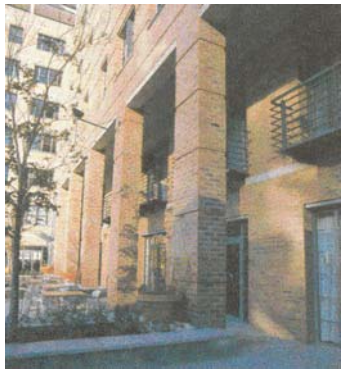


Fig 160. The piazza.

Fig 161. Detail of balcony overlooking the piazza.

Fig 162. East elevation.

A Social precedent: the Dance for All Programme:

'Dancing gave me hope and I'll never lose it. I'm going to be a professional dancer one day' - 15 year old Asanda Manhayi, from Dance for All, Khayelitsha. [Lund, 2002:67]

Philip Boyd, who started an outreach programme for Capab, now Cape Town City Ballet, started the Dance for All project ten years ago. The rigid Royal Academy Syllabus was not suited for all the dancers. In 1995, Philip renamed it Dance for All and included a range of other dance forms, from contemporary dance to jazz. Dance for All functions as an independent, non-profit company. This allows Philip to raise funds and pursue his vision, part of which is training enough students to the point where they can establish a professional dance company that travels the world teaching and performing. The first class had 34 students. 150 Students attend classes daily now in four township school halls.

Other than the R2 a class from the children who can pay, Dance for All, which costs R45 000 a month to run, relies solely on donation. [Lund, 2002:67]
Much needed donations are used to pay for dance kits, transport and medical expenses. Phyllis Spira, the former prima ballerina, is also committed to Dance for All. This programme is not just about dancing: it is about rehabilitation and upliftment, being mother and father to children who have often been abandoned, neglected and abused, taking ill students to the doctor, and dealing with domestic troubles such as alcoholism, drug abuse and violence.

Dedication of students and teachers paid off: one of the programme's first students, Theo Ndindwa, was given a full scholarship and was put straight into the second year of a three-year course at London's Rambert Ballet School after an audition. Students who don not become dancers will go into related careers in the theatre such as lighting, choreography or stage design. These children attending the programme have a natural rhythm and incredible talent. Through sheer determination and support they will make a career out of dance.

It was these heartbreaking and impoverished social situations that prompted Philip and Phyllis to create a Dance for All's scholarship programme. Twelve promising dance students were chosen and sponsored to attend Alexander Sinton High School in Athlone, where dance is a recognized matric subject. The programme includes school fees, books, dance clothes, food and private taxis that transport these children between home and school every day.

The programme is about learning life skills and self-respect. The music gives these children calmness and structure. Dance gives them discipline, confidence, self-respect and, above all, a capacity to dream. Not only does this all work to change their perceptions and raise expectations, but it also heals emotionally and physically.

Applicable concepts:
• Dance as a performance art give young people opportunities and hope for the future.

Fig 163. Dancers from Dance for All.

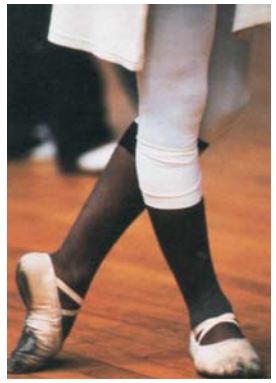


Fig 164. Dance change young lives in townships.

Fig 165. Dance is a ticket out of abject poverty.

Fig 166. Philip Boyd and his fellow instructors.

Design Development:

First concept, hierarchy of spaces:

The building will be mainly used by the following groups of users:

• The building functions as a community centre of sort that cater firstly for the immediate and direct users of the area. Performances, festivals, classes and outreach programmes involving dance will be available to the public. Educational programmes will be held, for children to the elderly and disabled.

• 20 students will be accommodated in the student housing. Underprivileged students gain the opportunity to follow careers in professional dancing, choreography and stage design through art sponsorship.

• Informal trading and small businesses will be accommodated in the shops and trading stalls.

As a result of this diversity in users the building functions were separated into different zones:

• Public zones: these areas can be seen as an extension of the public environment on the outside of the building. These areas need to be fully accessible to the public. Spaces include the central foyer, internet café, coffee shop, trading spaces, amphitheatre and the public environment surrounding the building.

• Semi-public zones: These spaces are still used by the public and the students, but need to be more quite as a result of specific activities. These spaces include the education centres.

• Semi private: these are private areas used communally by the students. They include the student foyers, self-catering facilities, laundromats, lounges and dance studios.

• Private areas: these areas include the student housing units.

The northern facade of the western wing of the building containing the shops, education centres and student housing needed to be articulated to define the different zones of usage. The facade is defined into horizontal planes, breaking the totality of the single vertical plane.

"The public edge of the building should house activities which benefit from interaction with the public realm, and can contribute to the life of the public space itself." (Bently, 1985:63)

The public zone containing the colonnaded base serves as a transitional zone between the interior of the retail spaces and the public environment of the setback pavement. The private zones containing the student housing has balconies looking out unto Jeppe Street. This threshold gives more privacy to the student housing units.

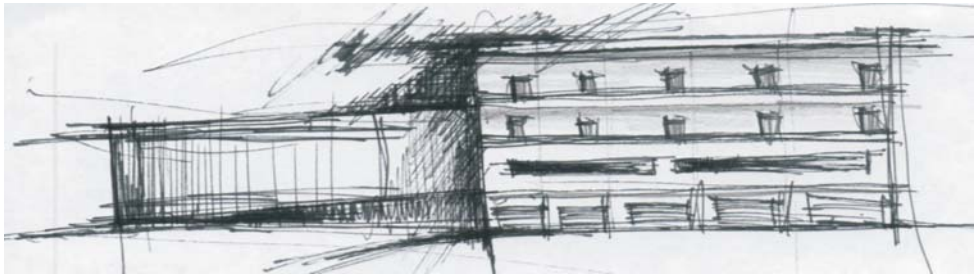
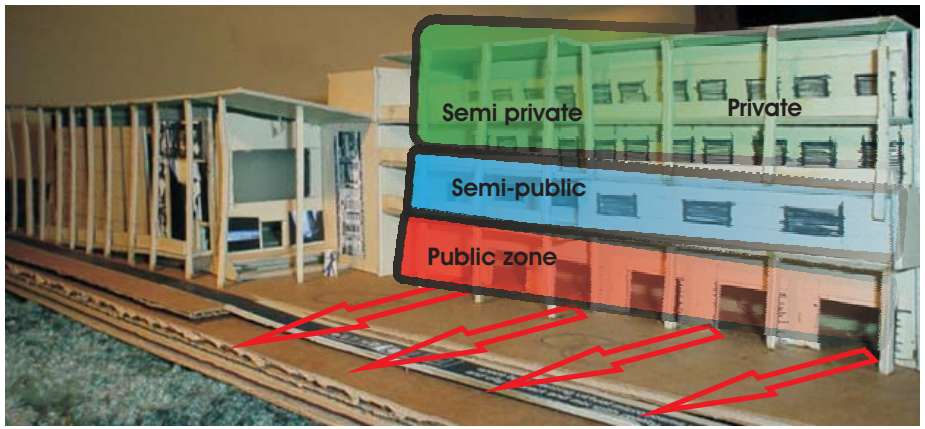


Fig 167. Definition of the facade into zones.



Concept development:

Several theories and guidelines were taken into consideration for the development of a concept. Various conceptual stages were worked through until the final concept was established. The process will be discussed chronologically.

The first concept:

The urban design guidelines set in the Newtown Cultural Precinct Urban Design Plan stated that buildings should define public space by establishing a facade line of buildings directly along the boundaries of the public space. This was achieved on the site by creating a hard edge along Jeppe and West Streets. The mechanisms used to ensure that buildings stand on their boundary lines are the mandatory build to lines along these two streets. These two hard edges worked with the opportunity to use axes along these two roads. Axial directions were used to create a composition of lines that unite in a spatial form of rhythms around these axes.

The main form of the building was established as a solid mass on the corner of Jeppe and West Streets with the edge of Jeppe Street extended up to the Turbine Hall to create a continuous edge. The interior of this mass was considered to be developed into a semi-private courtyard. This courtyard developed into the internal performance space.

The main axes divided the building mass into a more public performance zone on the corner of Jeppe and West and a more quieter education centre/student housing zone along Jeppe Street. This implied that certain zones of the building will function separately from others for the sake of privacy and security.

The first concept developed into a semi-private courtyard for the students, while the amphitheatre moved from towards the more public route along West Street. The amphitheatre needs to function as a transitional link between the public Turbine Square and the performance space inside the building.

Fig 170. First concept: the northern facade.

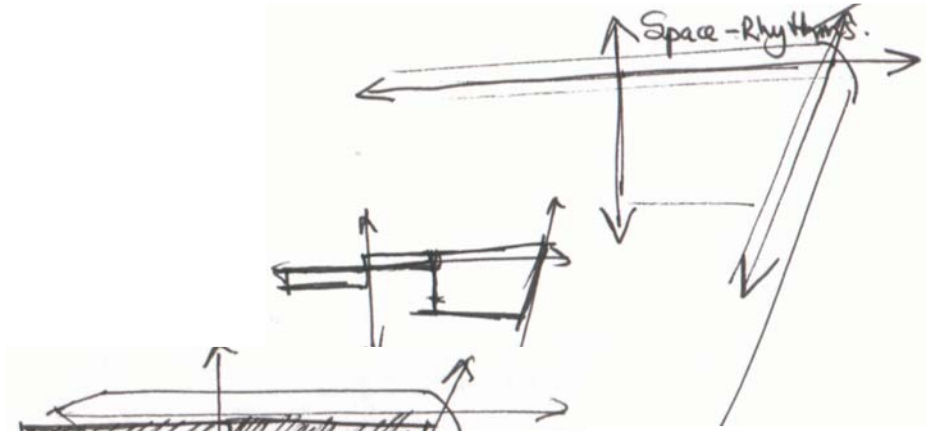


Fig 168. Concept development with the use of axes and spatial rhythms.

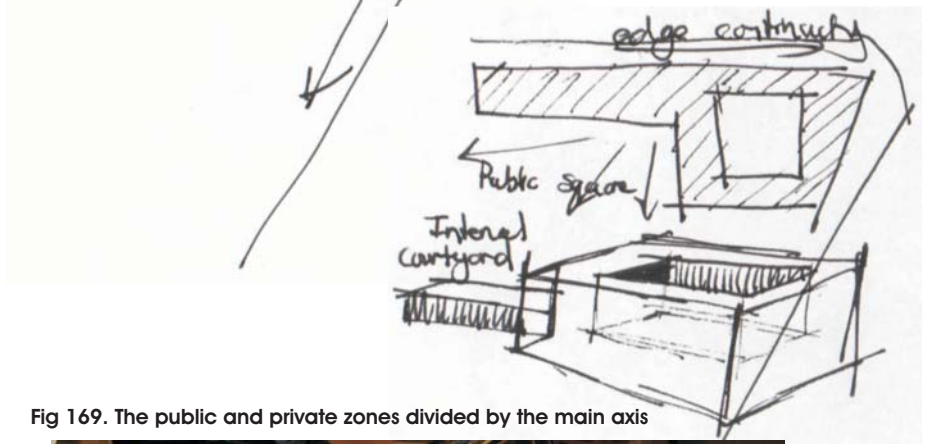
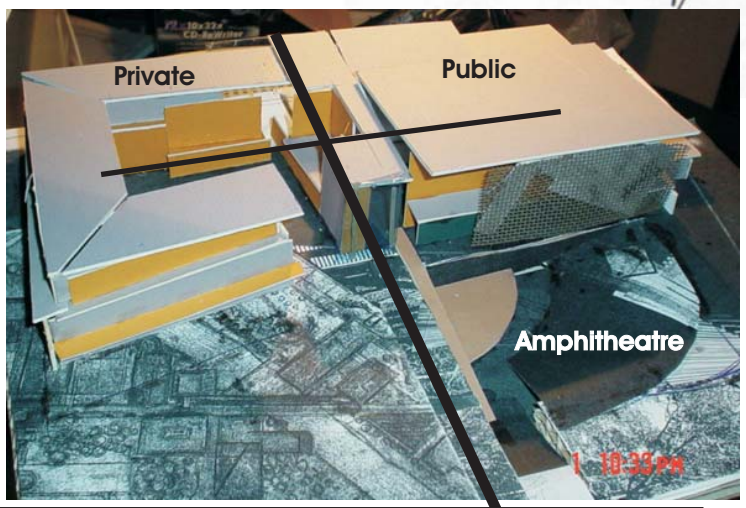


Fig 169. The public and private zones divided by the main axis



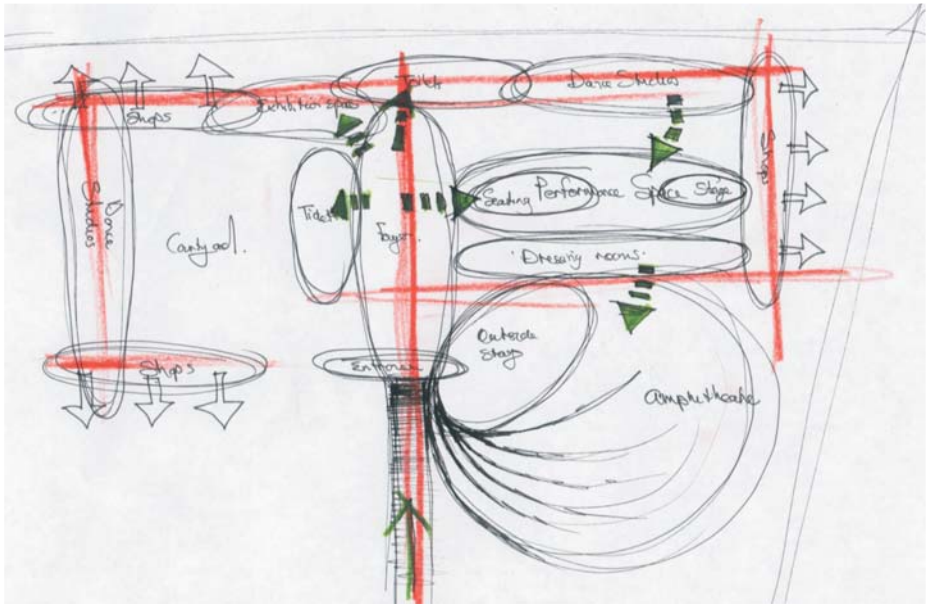


Fig 171. Relation between different functions in the building.

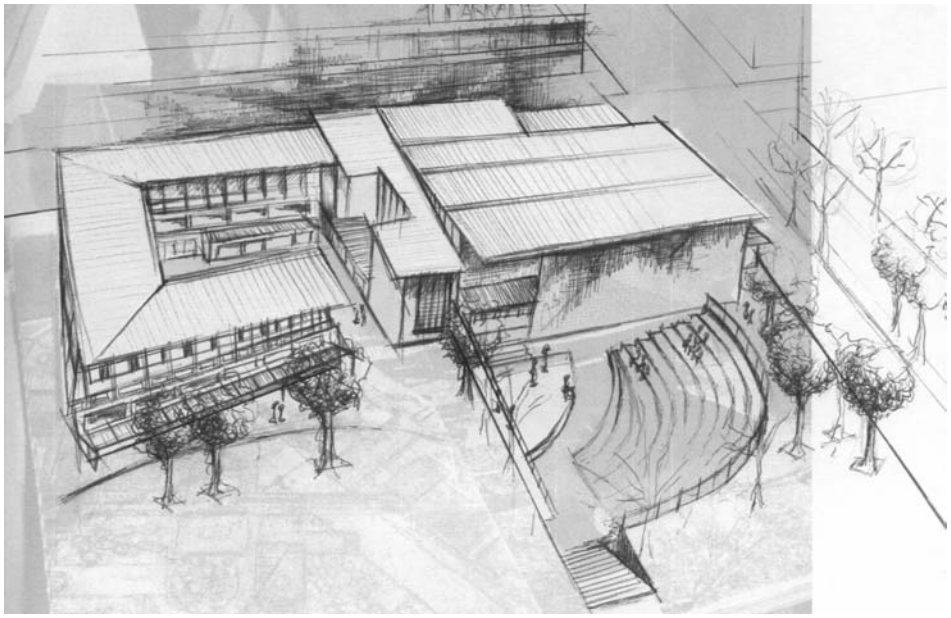


Fig 172. Perspective showing the first concept of the building

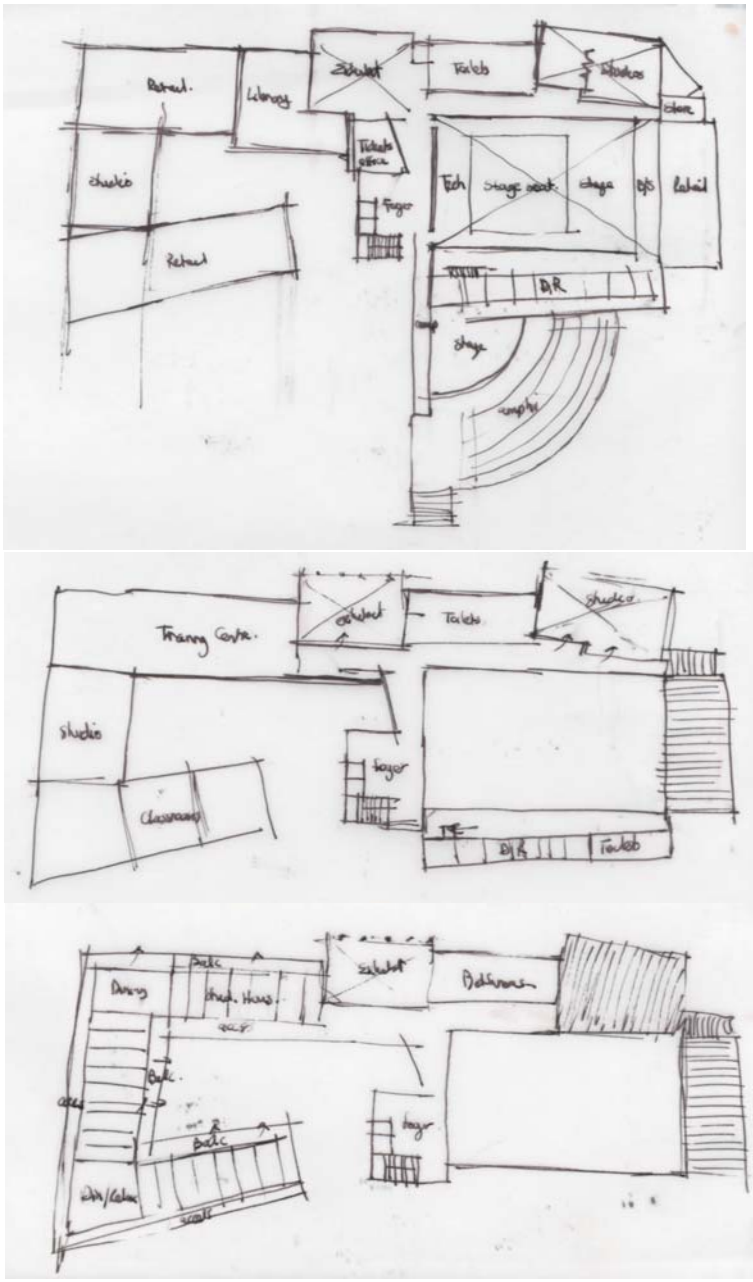


Fig 173. First concept: sketch plan development.

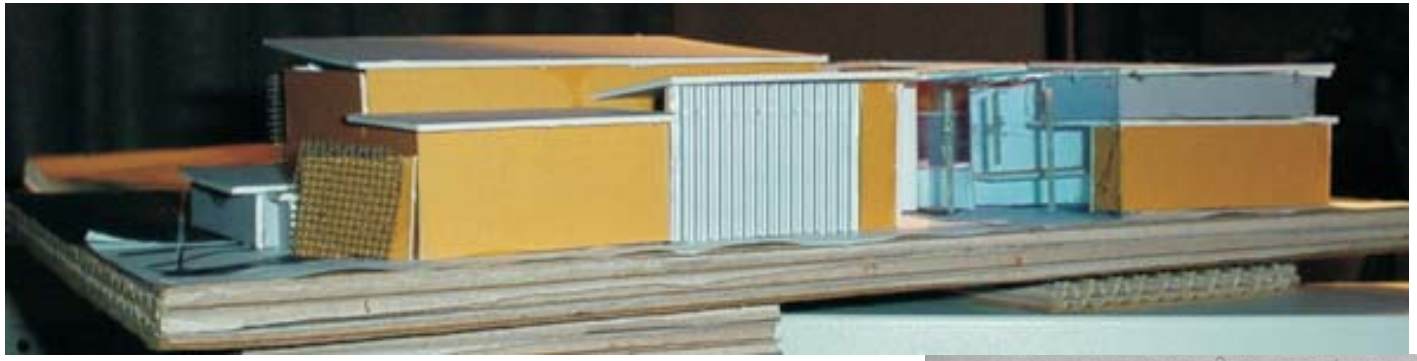
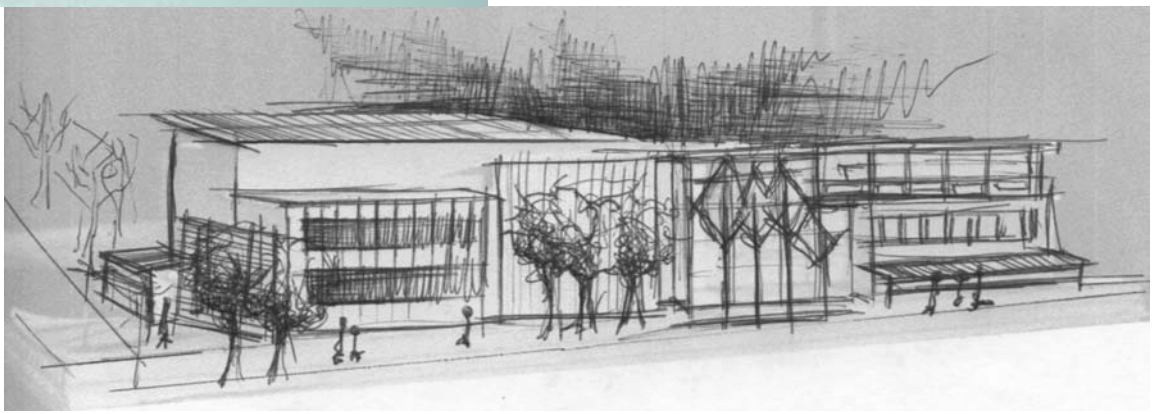


Fig 174. Corner of Jeppe and West Street.



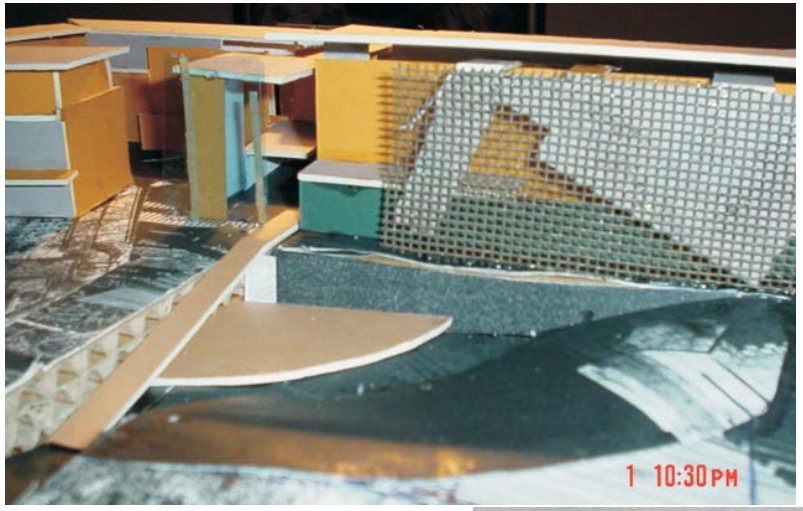
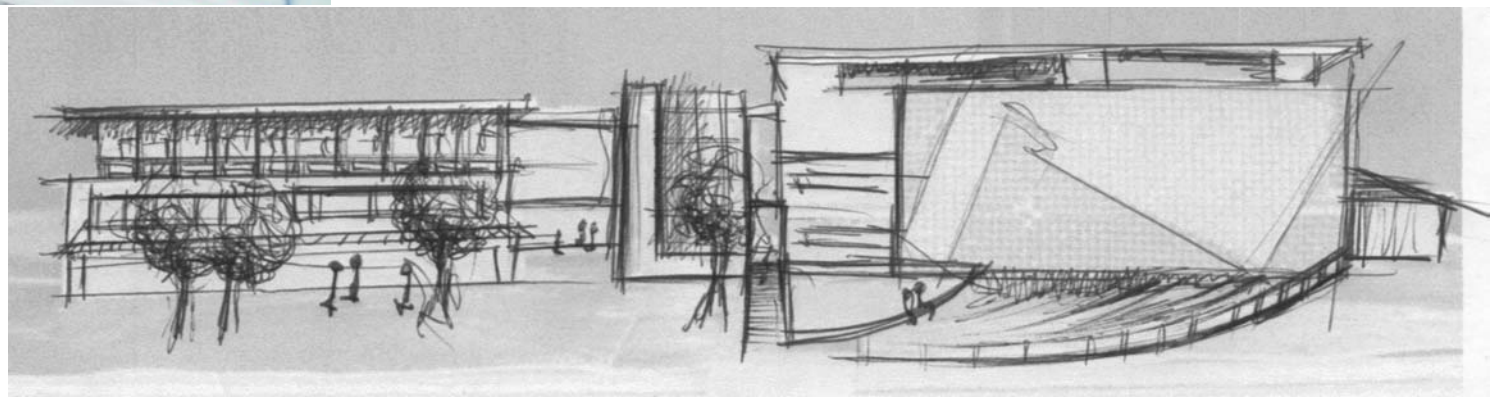


Fig 175. The ramp giving access to the building from the square and the amphitheatre



The second concept, development of the site:

The Turbine Square:

It is proposed in the Newtown Cultural Precinct Plan that the space adjoining the new development and the Turbine Hall be developed into The Turbine Square. This square forms an important node in the public environment running through the precinct.

Responsiveness:

The importance of a double frontage development became clear. The building needs to respond towards three directions:

- North towards Jeppe Street
- East towards West Street
- South towards the Turbine Hall

Small shops flow out unto the setback space along Jeppe Street, while informal trading

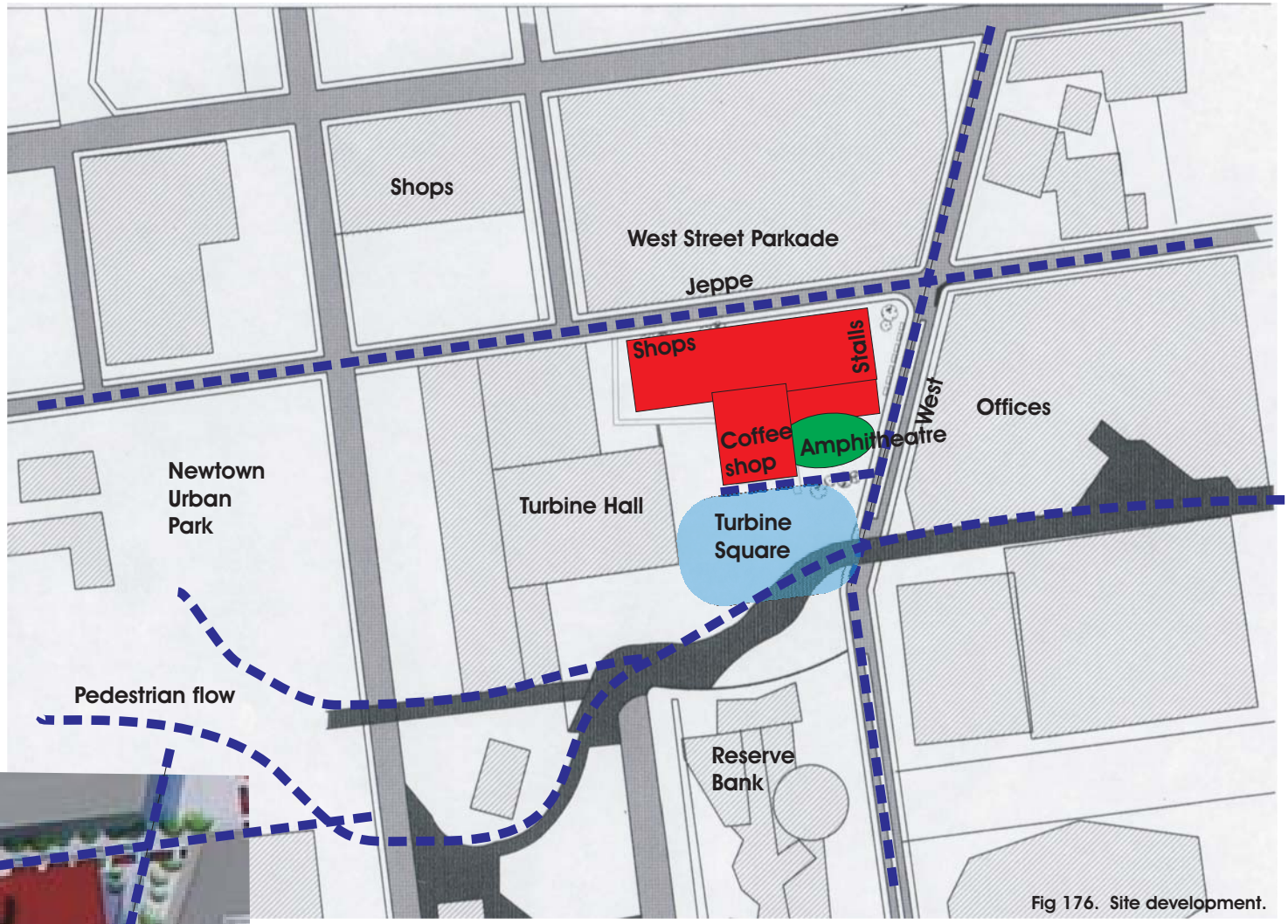


Fig 176. Site development.

stalls draw activity in along West Street. The amphitheatre and Internet/coffee shop would draw activities in from the square.

Main entrances:

Two main routes of pedestrian flow, from the west(Mary Fitzgerald Square) and from the east(Inner city) established two separate entrances possible. The central foyer needed to be accessible from both directions. All entrances needs to be clearly visible and legible. The ramp clearly indicates the entrance from the corner of Jeppe and West Street. The setback space in front of the entrance for the western movement is clearly

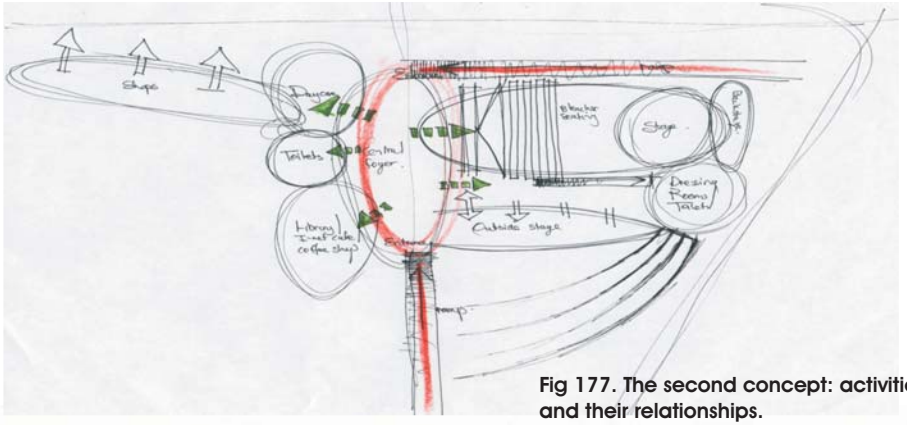


Fig 177. The second concept: activities in the building and their relationships.

Fig 181. The second concept model

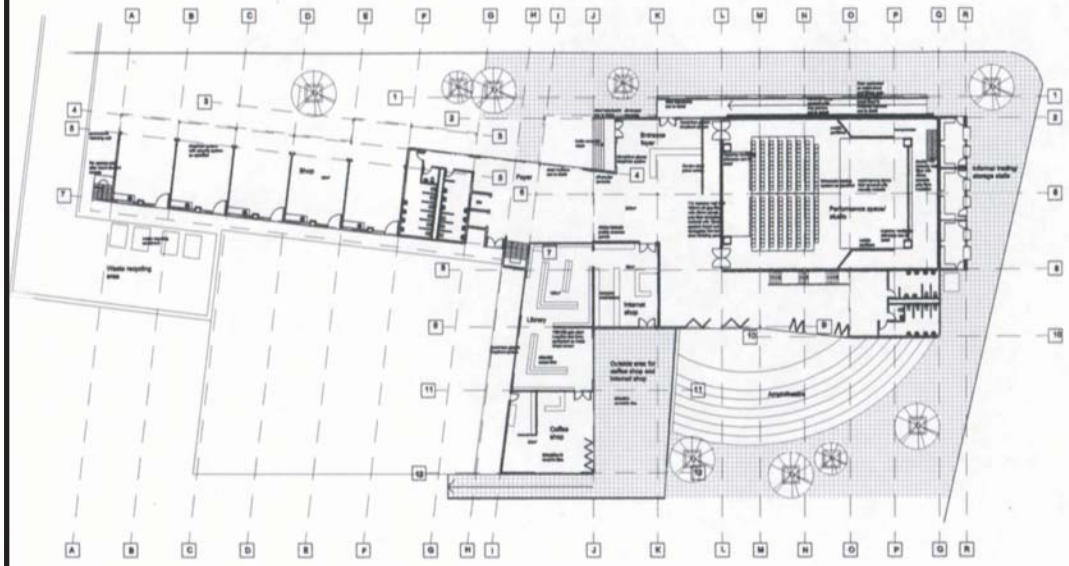


Fig 178. Ground floor plan

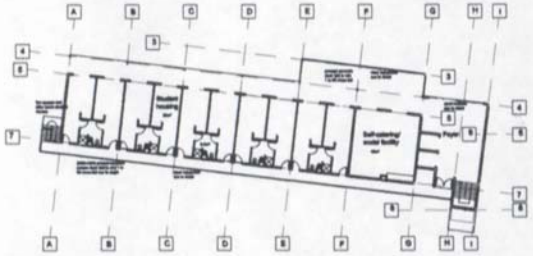


Fig 180. Second and third floor plans

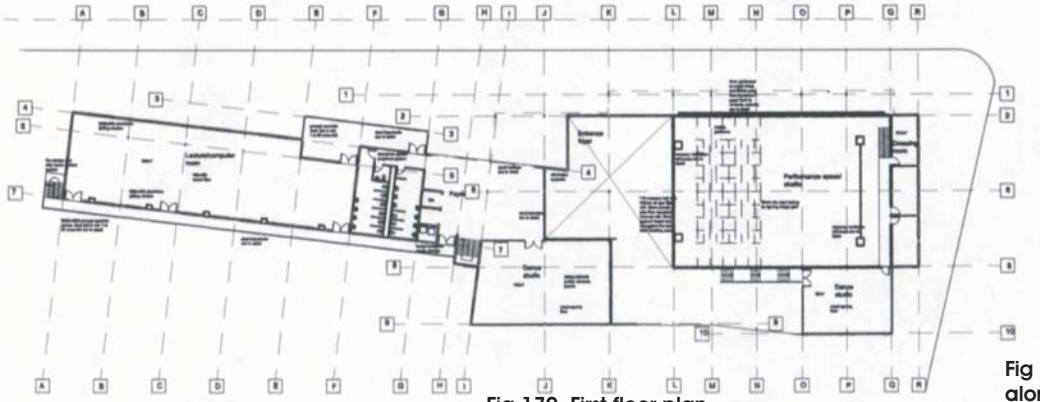


Fig 179. First floor plan

Fig 182. Informal trading spaces along West Street

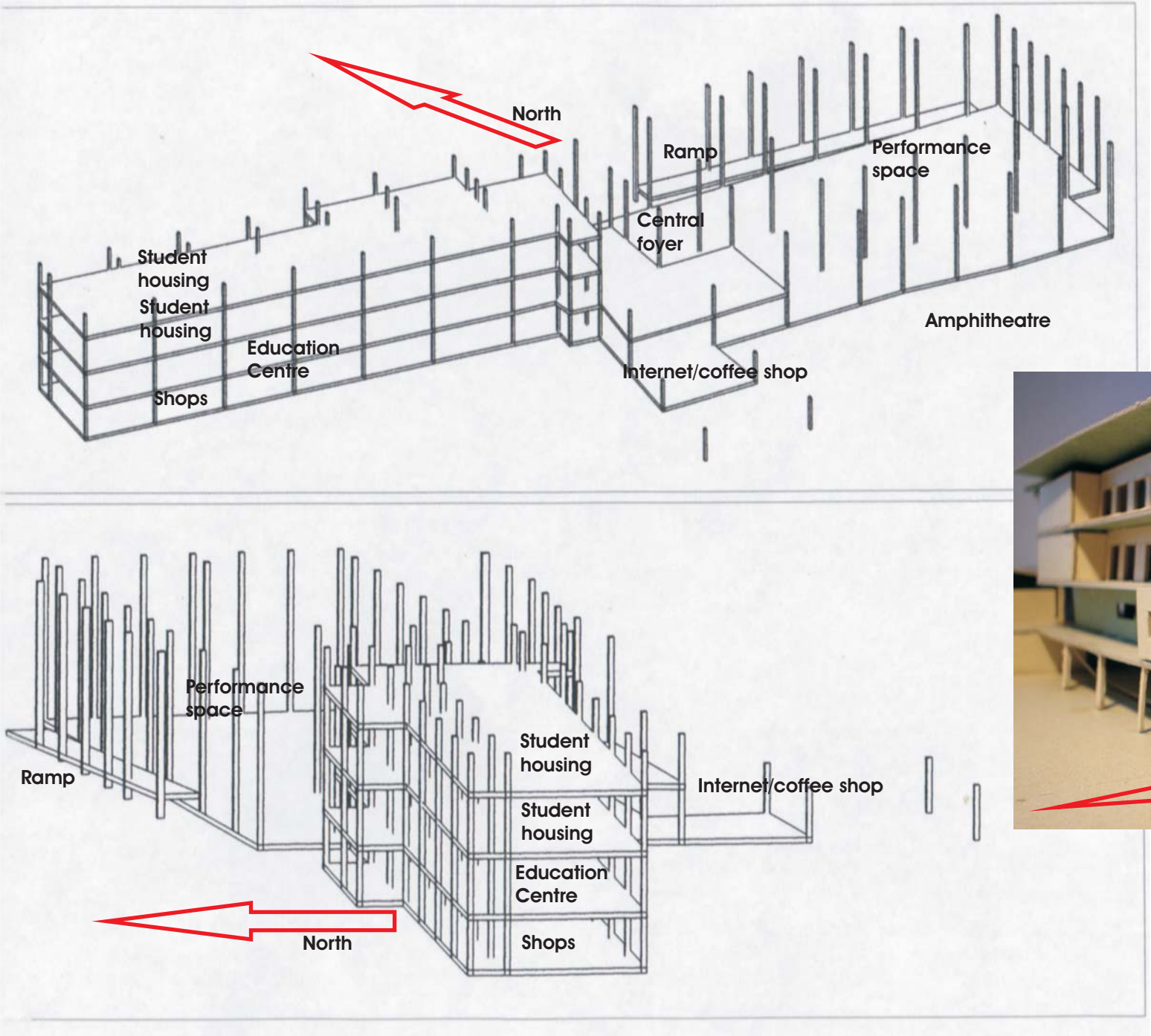


Fig 183. Structure of the second concept of the building

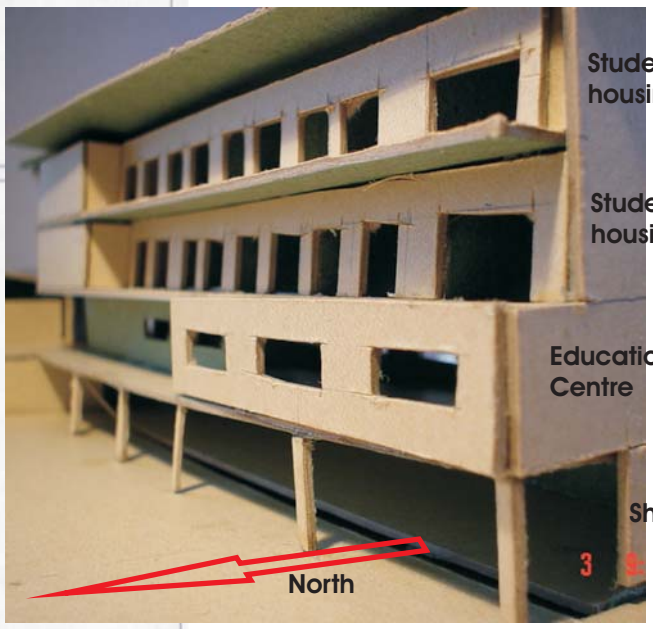


Fig 184. Northern facade

visible from the flow of pedestrian movement. The amphitheatre and outside stage is an intermediate space between the interior of the building and the square.

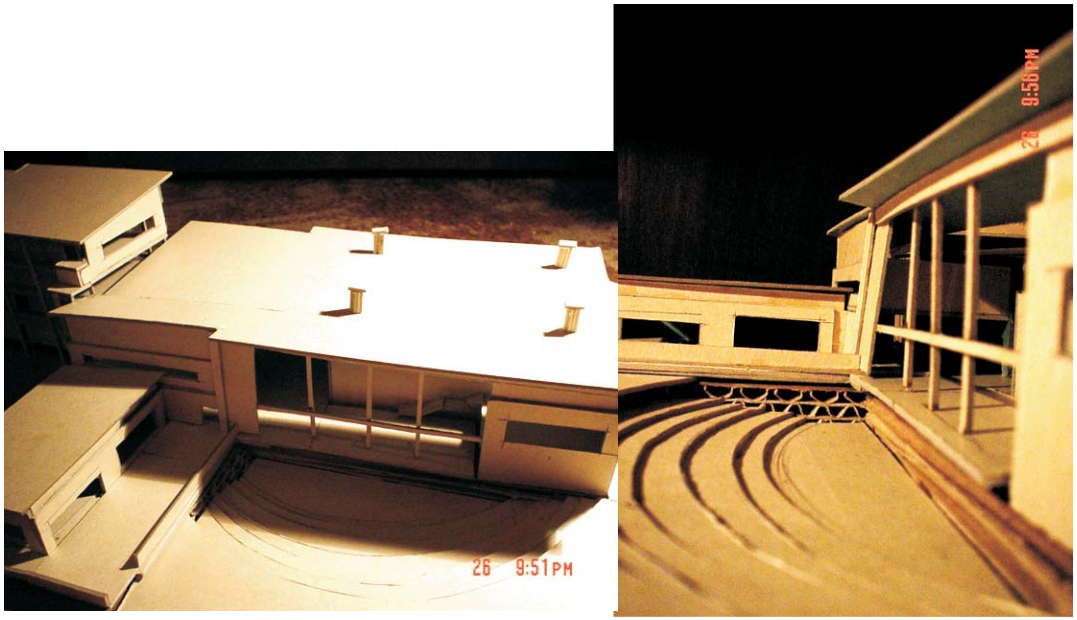


Fig 185. Amphitheatre and outside stage

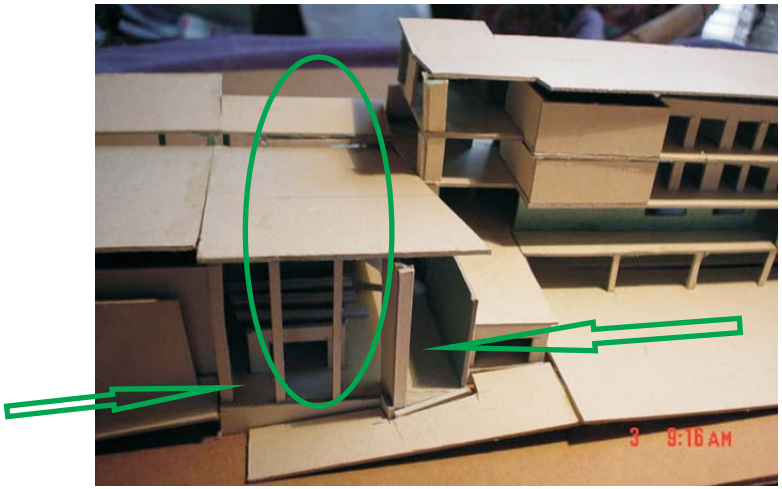


Fig 186. Two entrances and the central foyer

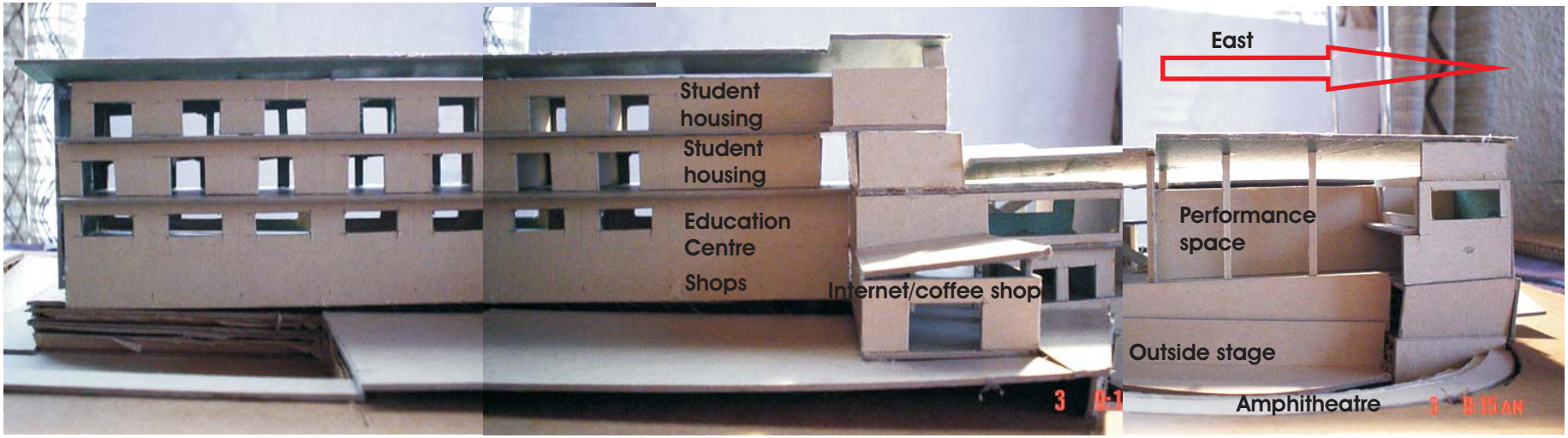


Fig 187. Southern facade

The final concept, accessibility:

The second concept showed problems concerning accessibility from the South. The amphitheatre itself needed to be responsive to two directions; looking unto the outside stage area and towards the square. The east-west orientation of the performance spc changed to a north-south direction. This changed the stage into a double-sided spac The stage is now an "open stage" which can be viewed from the bleacher seating or the amphitheatre. The stage extends to and outside stage. This creates a different performance environment to the usual, drawing the public space into the building. T use of the movable acoustic panels allows this multi-functional usage of space.

In the final concept the southern boundary became more accessible towards the squ The coffee shop opens up towards the square and the first floor looks out unto the outs stage area. The eastern edge containing the trading stalls became more defined.

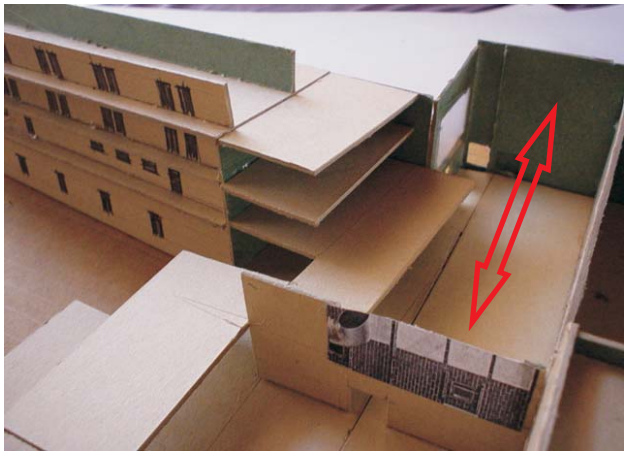


Fig 188. New north-south orientation of the performance space

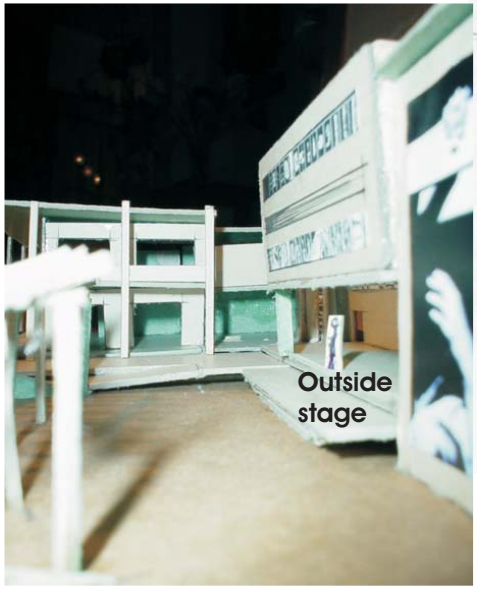
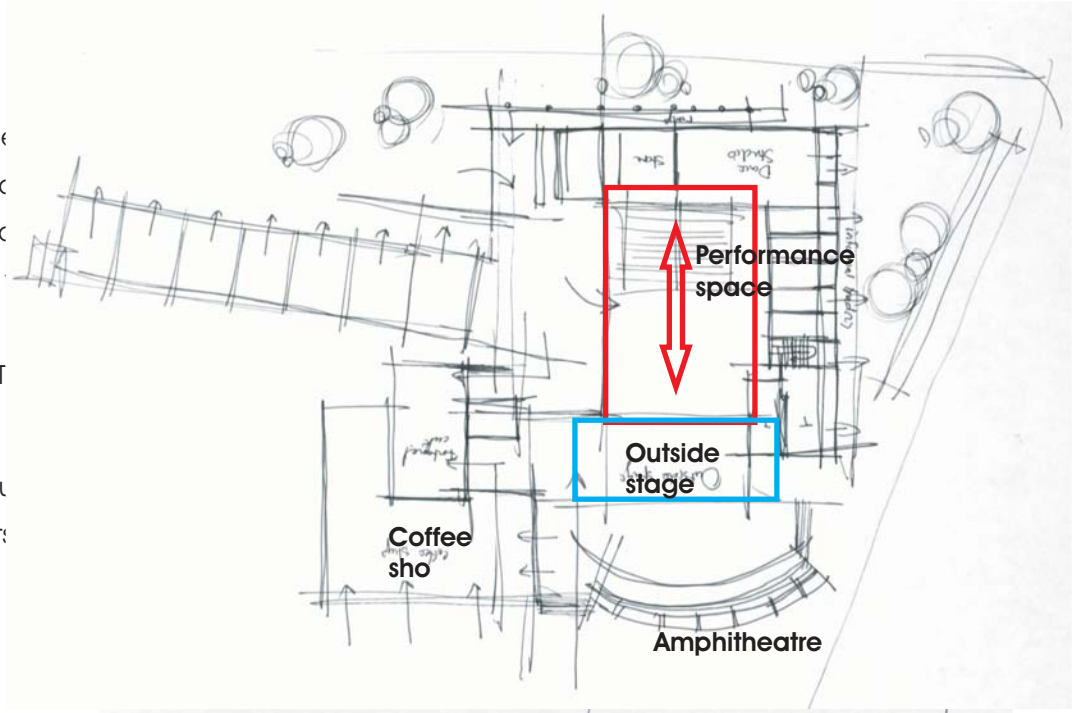


Fig 189. The outside stage creates a different performance environment



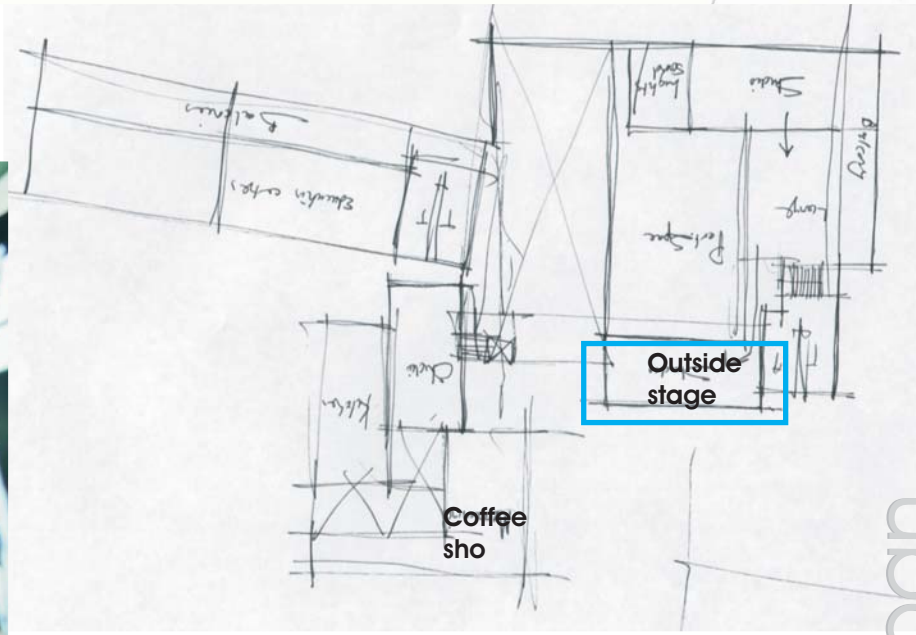


Fig 190. Final concept: sketch plan development

Development of the section:

The development of the section involved seeking solutions for spatial experience, views and the establishing of a human-scaled environment.

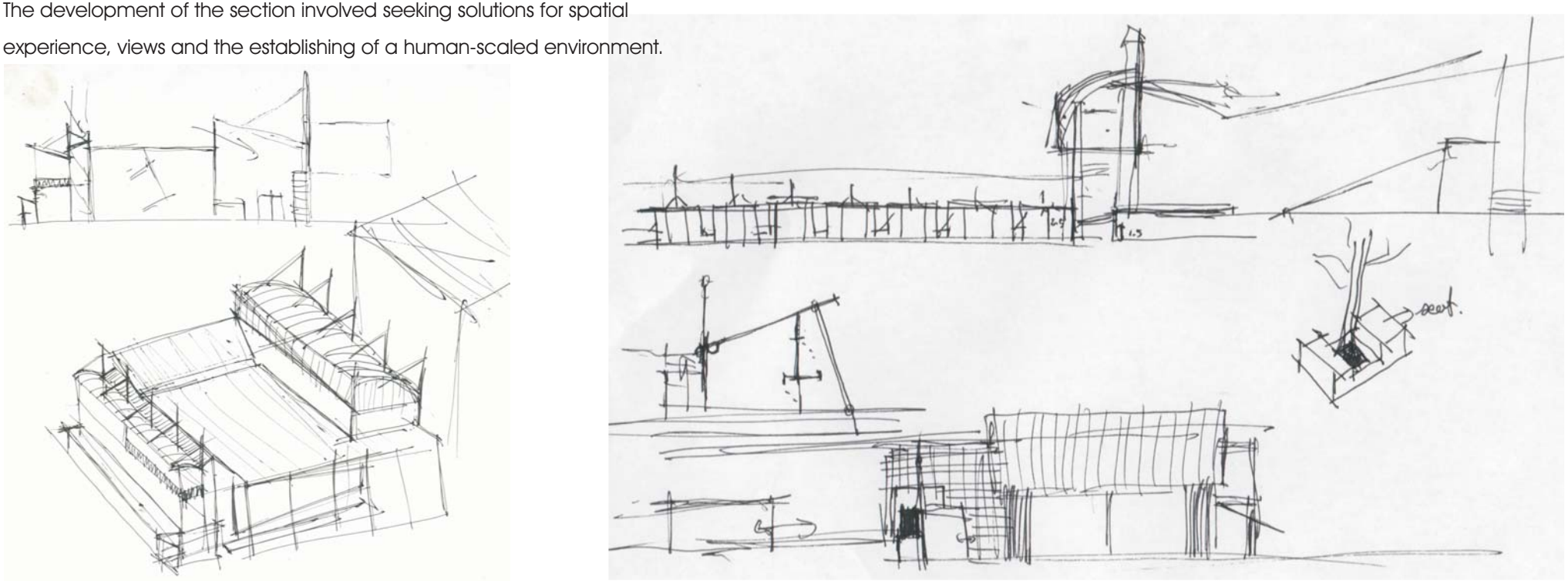


Fig 191. Development of the section

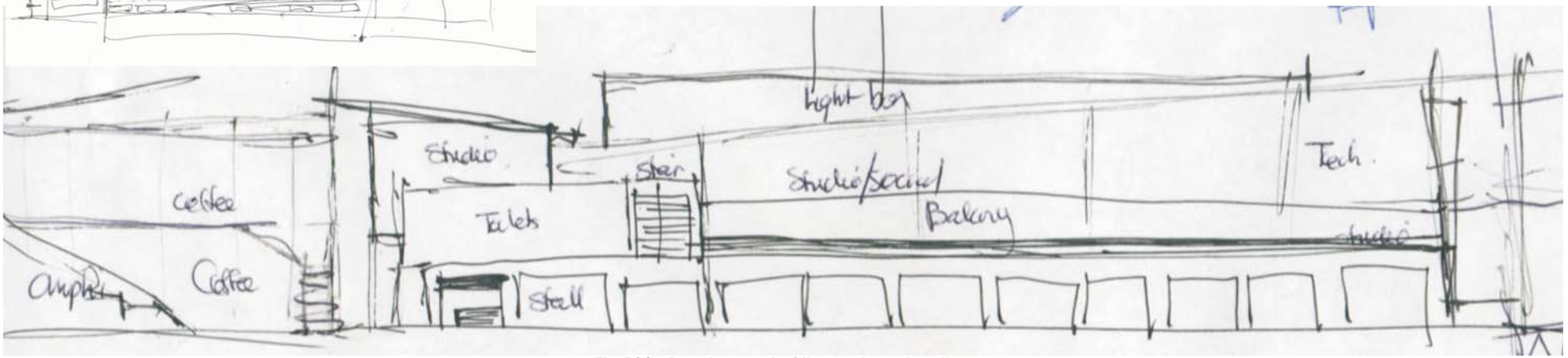


Fig 192. Development of the eastern elevation

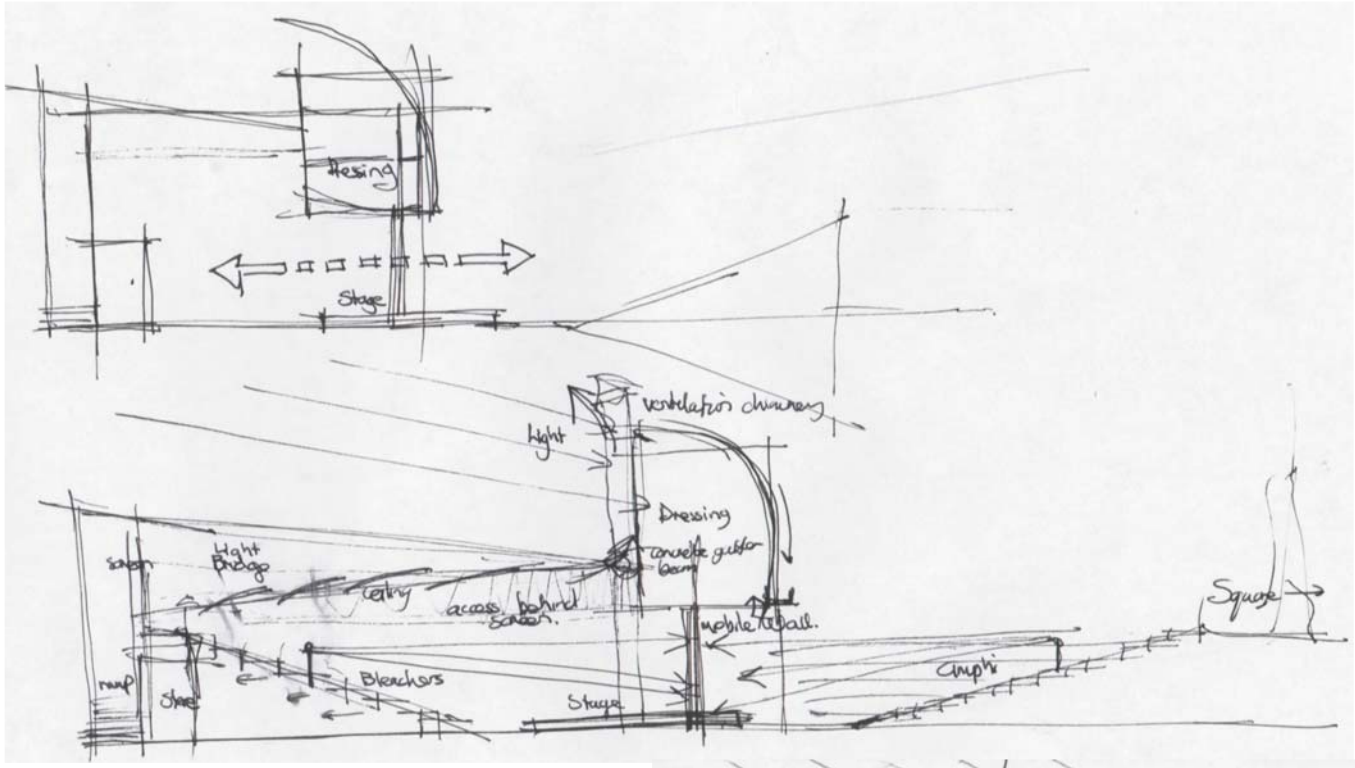
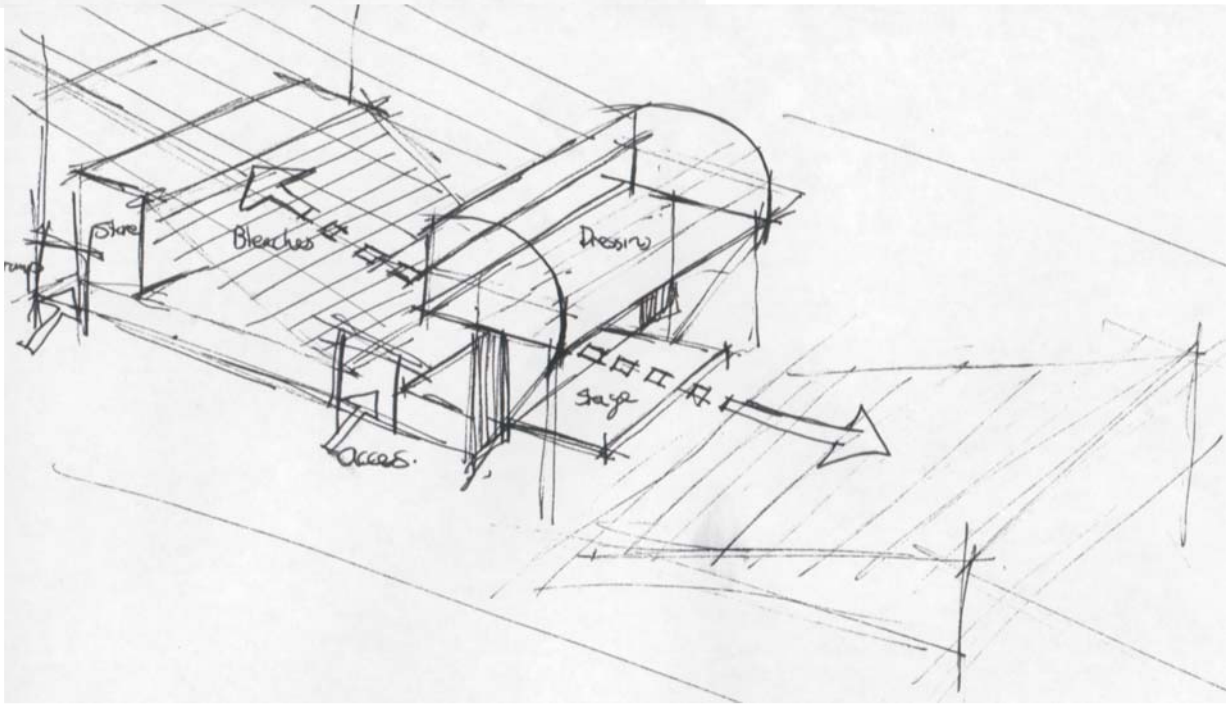


Fig 193. Development of the section



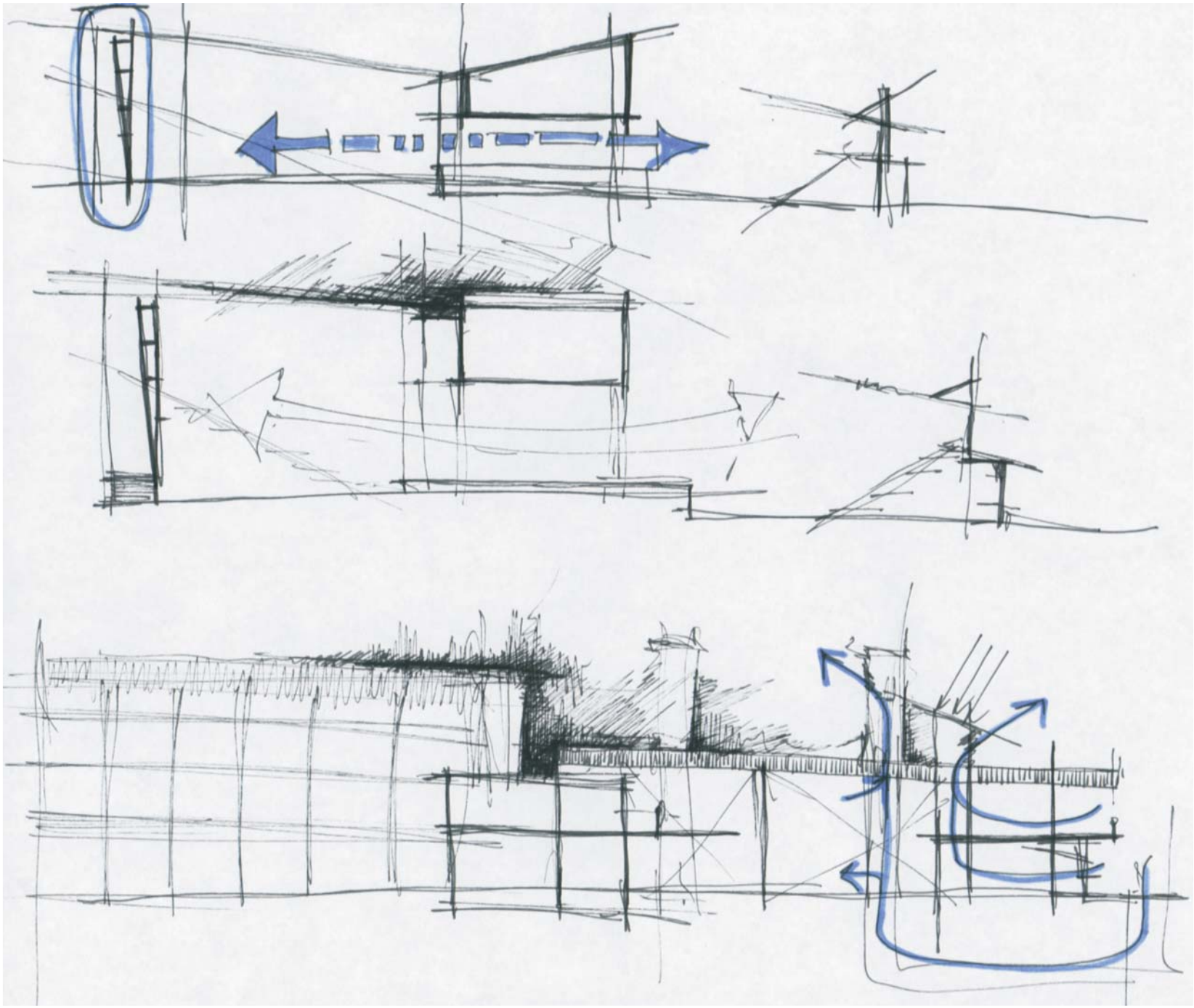


Fig 194. Development of the section

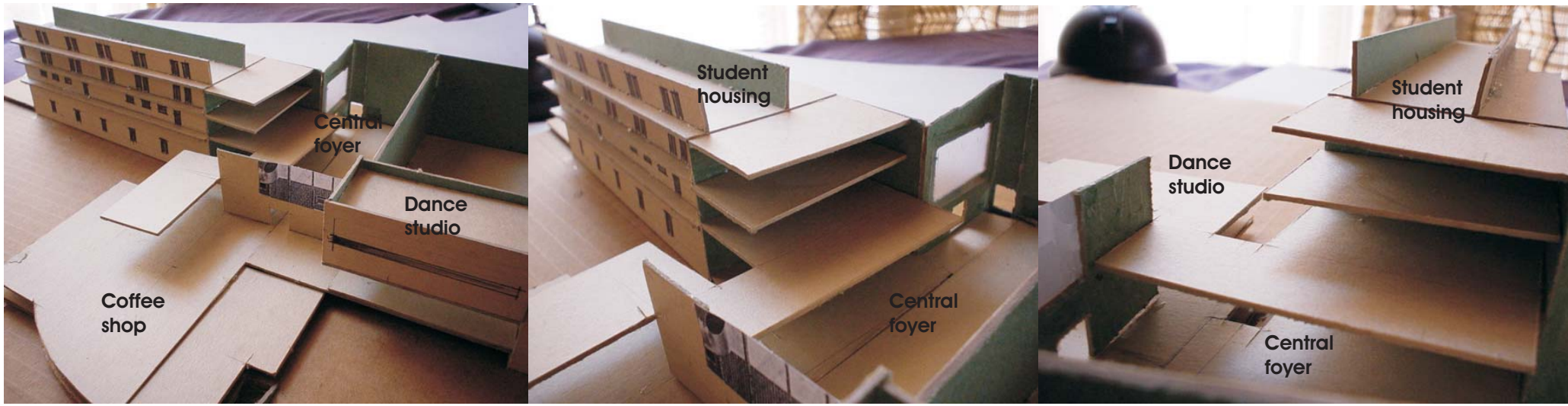
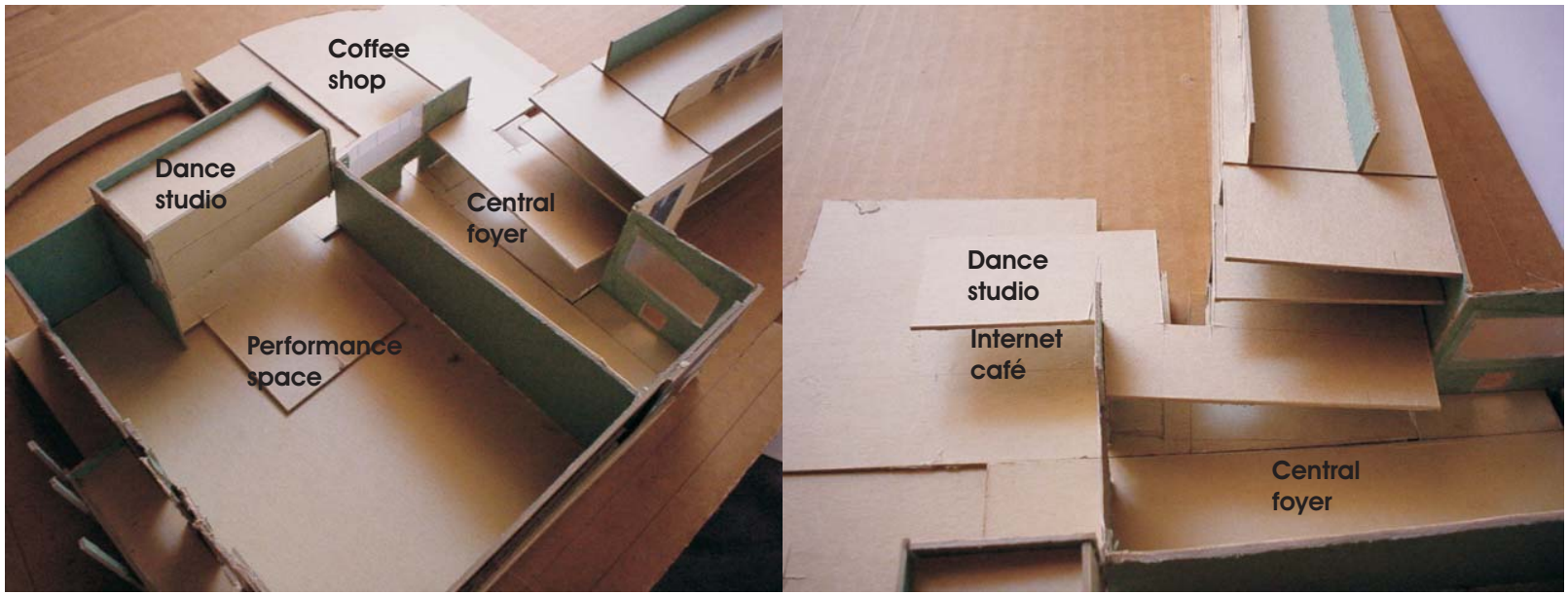


Fig 195. Three- dimensional development of the final concept.



Development of details:

Movable acoustic panels were needed to separate the internal performance space from the outside stage. This enables the performance space to accommodate uses during the day and night. These panels rotate along an axis to be stacked together at the side walls of the stage. A pen runs in a guiding channel at floor level to keep the panel stable.

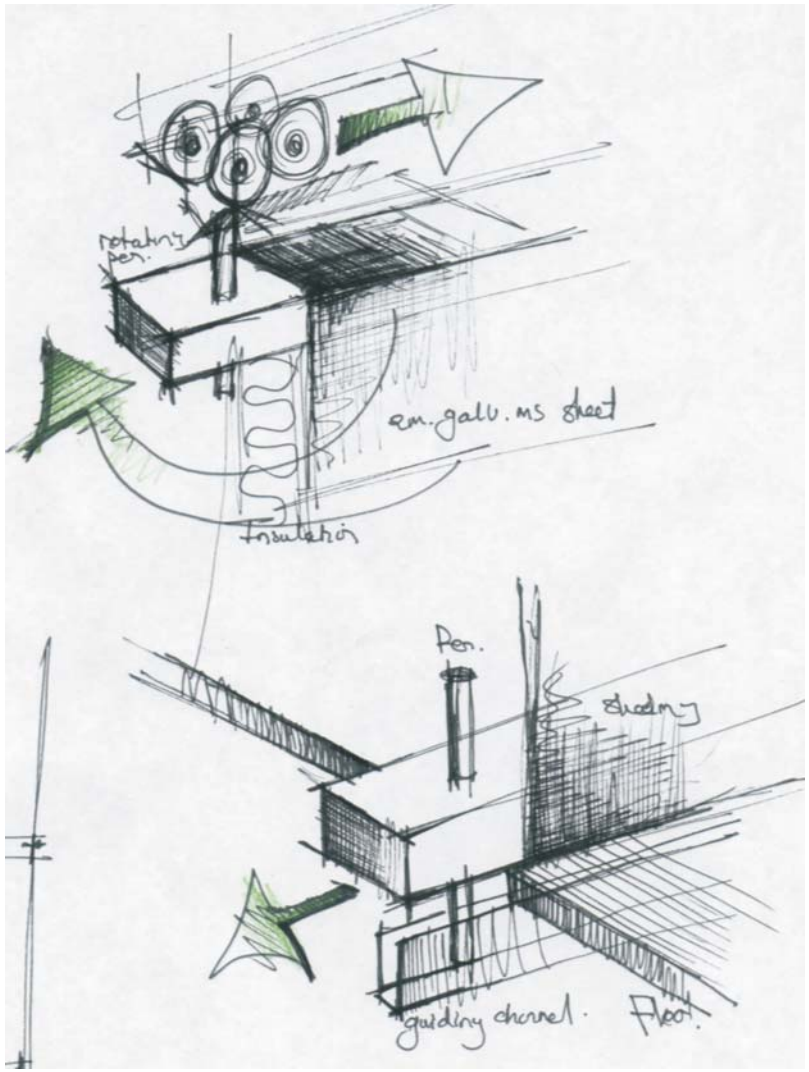


Fig 196. Concept drawing of the panels

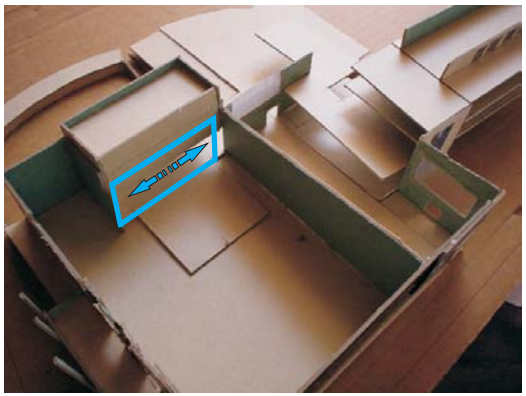
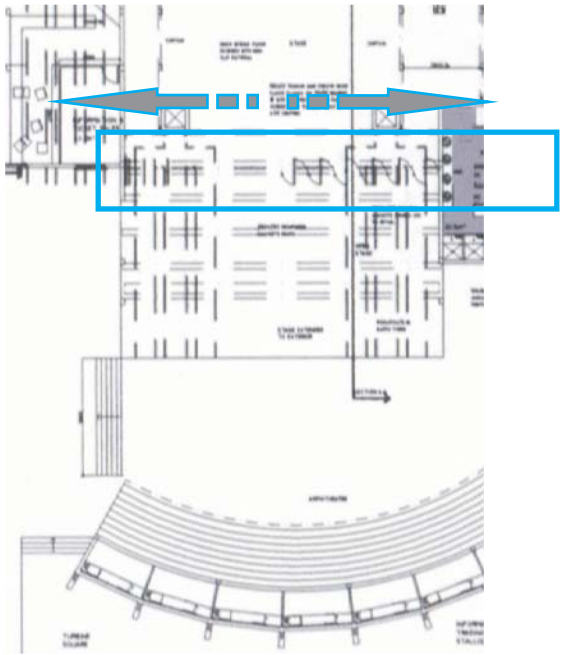


Fig 197. Location of the panels



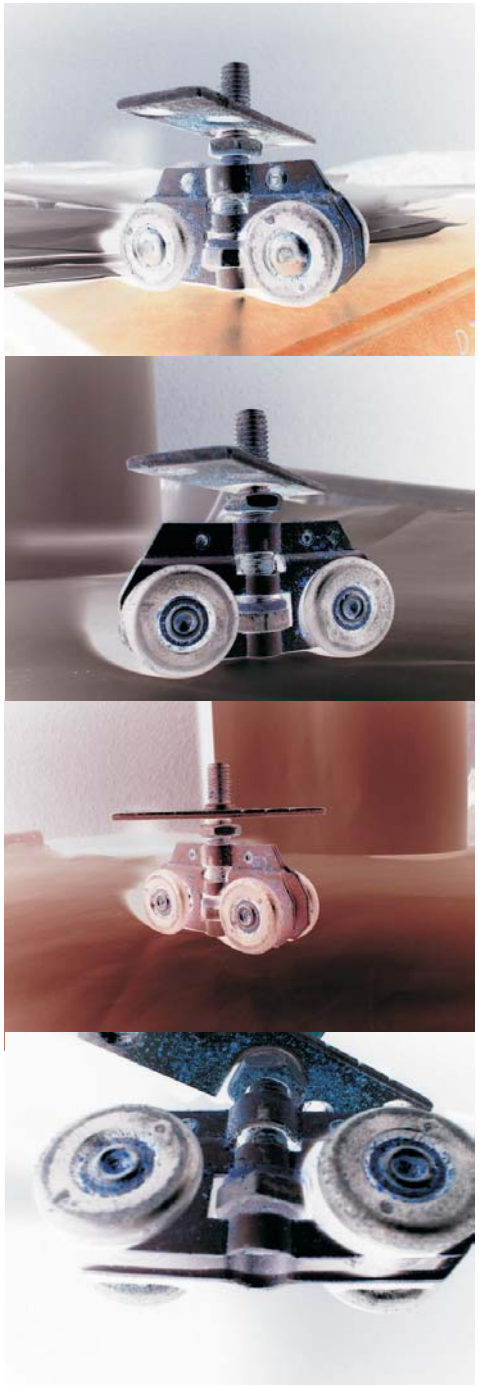
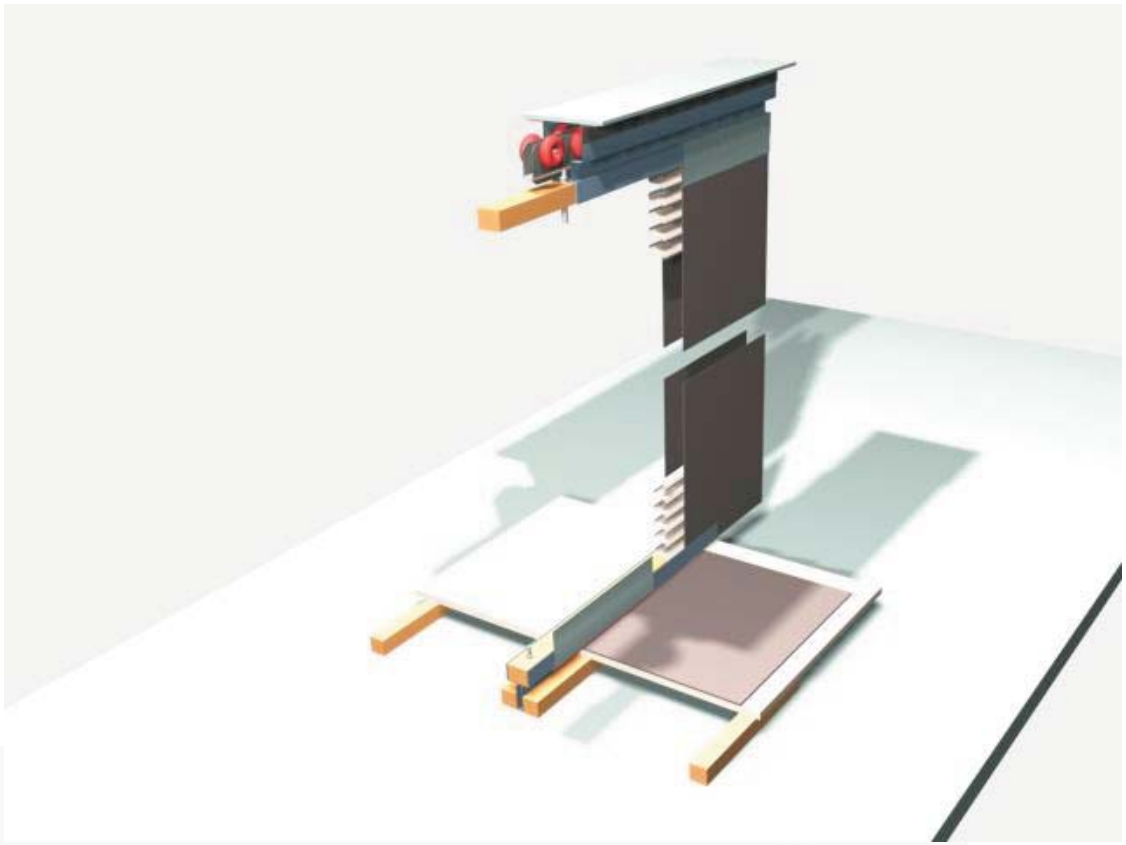


Fig 198. Rotating system with wheels



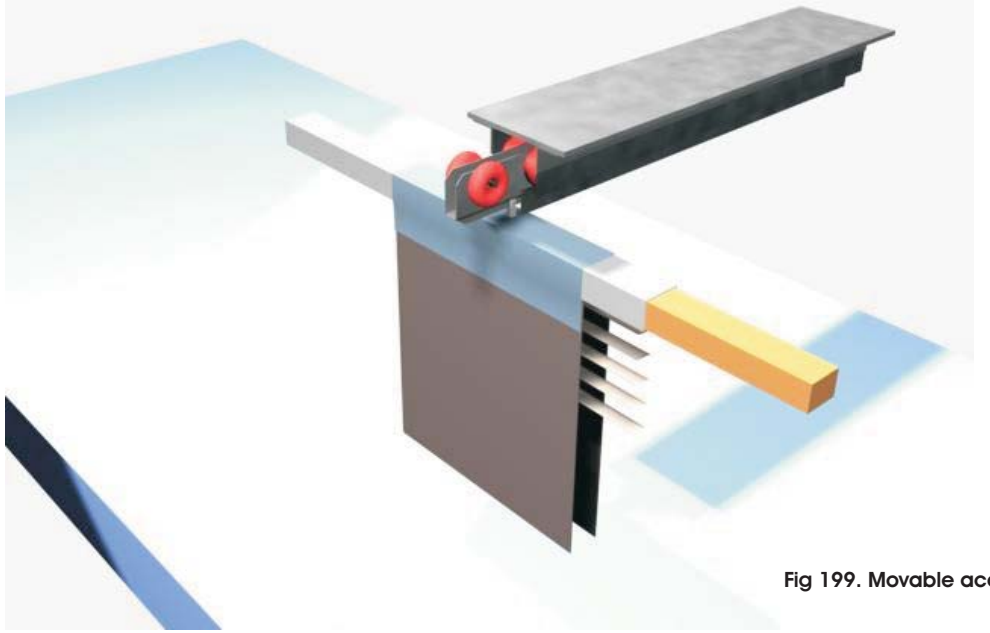


Fig 199. Movable acoustic panel.

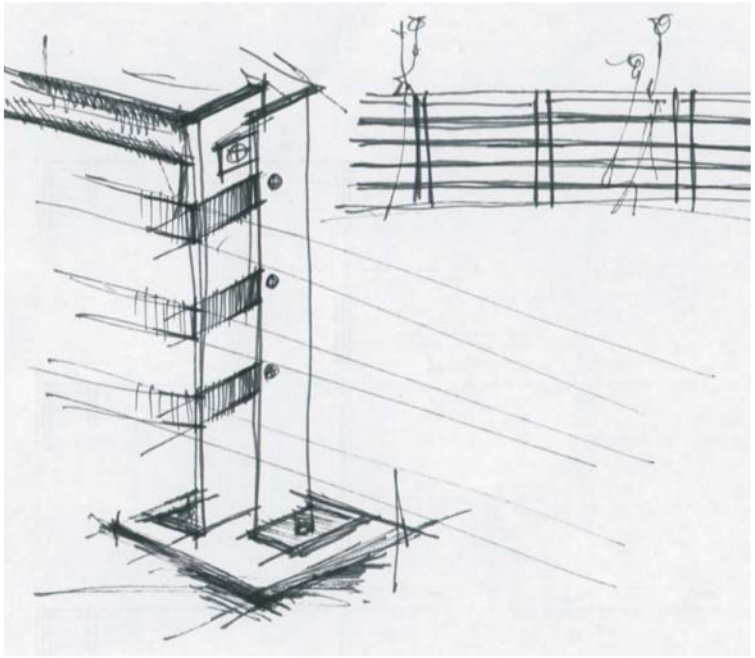


Fig 200. Concept drawing of the steel balustrade.

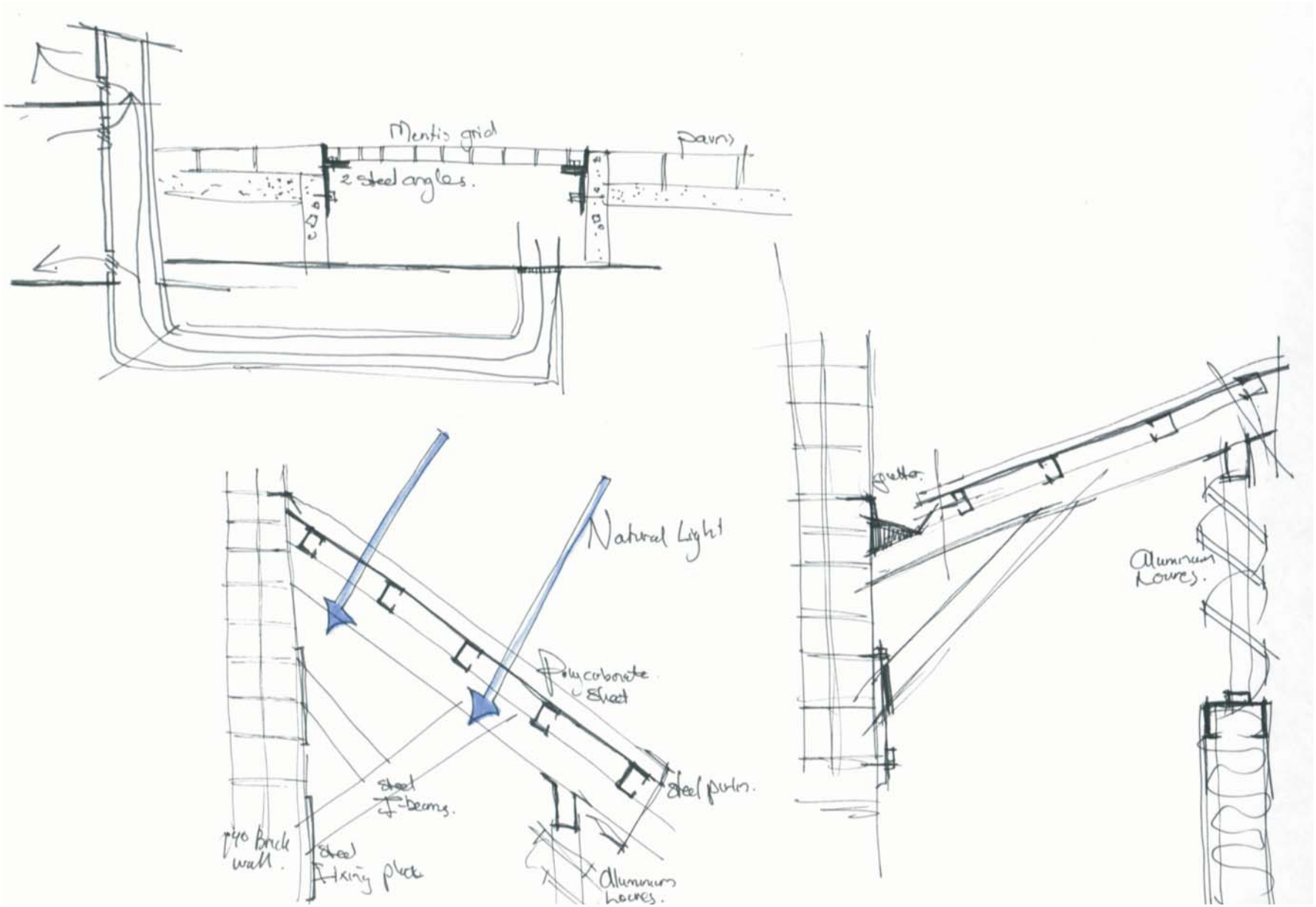


Fig 201. Concept drawings of the details.

Reflecting context in the details, historical context:

The building is situated next to the Turbine Hall. This historic building was the first coal-fired power station in Johannesburg. This building is now Johannesburg's newest music venue. The broken windows are kept in place as a reminder of the building's haunted past. It was important that the new building should be designed in respect of the historical context. An analysis and reinterpretation of historical clues ensured that the elevation treatment and facade modulation reflected the historical context. The shape of the Turbine Halls' windows has a 1:1.5 ratio. This proportion is expressed in the design of the sound-absorptive screen running along Jeppe Street. Rectangular apertures are punched through the panels in an erratic, scattered manner to reflect the broken windows of the Turbine Hall.

Fig 202. The broken windows of the Turbine Hall.

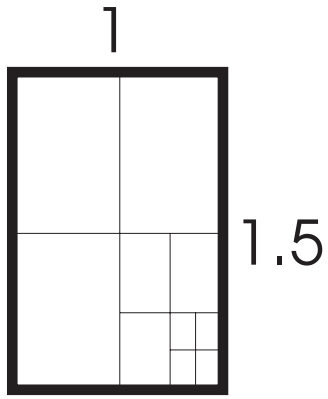


Fig 203. The 1:1.5 ratio of the windows.

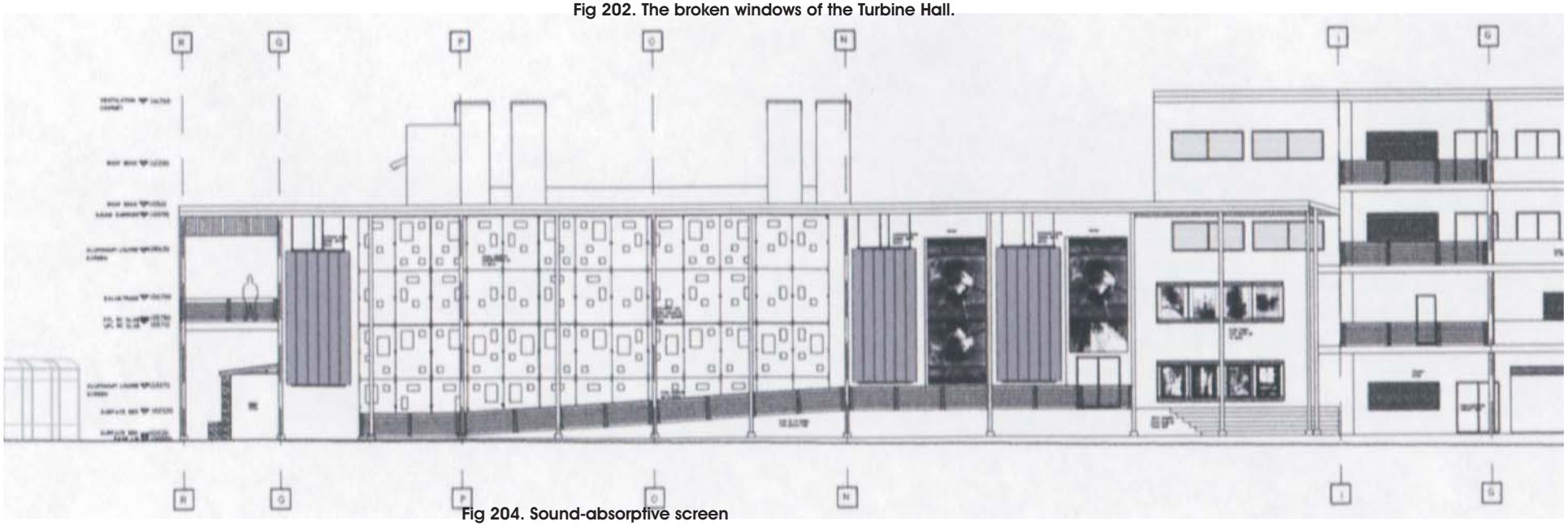


Fig 204. Sound-absorptive screen

Reflecting context in the details, visual art for urban regeneration:

"Transforming the City of Johannesburg into a huge art gallery, attracting local, national and international attention … This intervention represents an unusual affirmation of the importance of arts and culture to the life of a city; not only has this awakened a new sense of energy and dynamism in the public and private sector, it has also taken South African contemporary art into the public arena." (Ludman, 2003)

Business and Arts South Africa honoured the city of Johannesburg for its campaign to use art for urban regeneration. This innovative and imaginative form of art sponsorship was designed to ignite urban regeneration and to draw people back into the inner city.

Johannesburg became an outdoor art gallery when the "JHB ART CITY" visual arts exhibition Wall Project went on show during the World Summit on Sustainable Development in 2002. Works of art by South African artists were enlarged and displayed on buildings in the city. The chosen works are scanned and enlarged without distortion to be displayed as massive murals on the sides of buildings or on billboard-style mountings. Originals of the works are displayed at venues around the city, like the Electric Workshop.

These art-in-the-city projects makes visual art more accessible to Johannesburg's citizens in their every day lives. The displays beautifies the urban environment to a place people can be proud of.

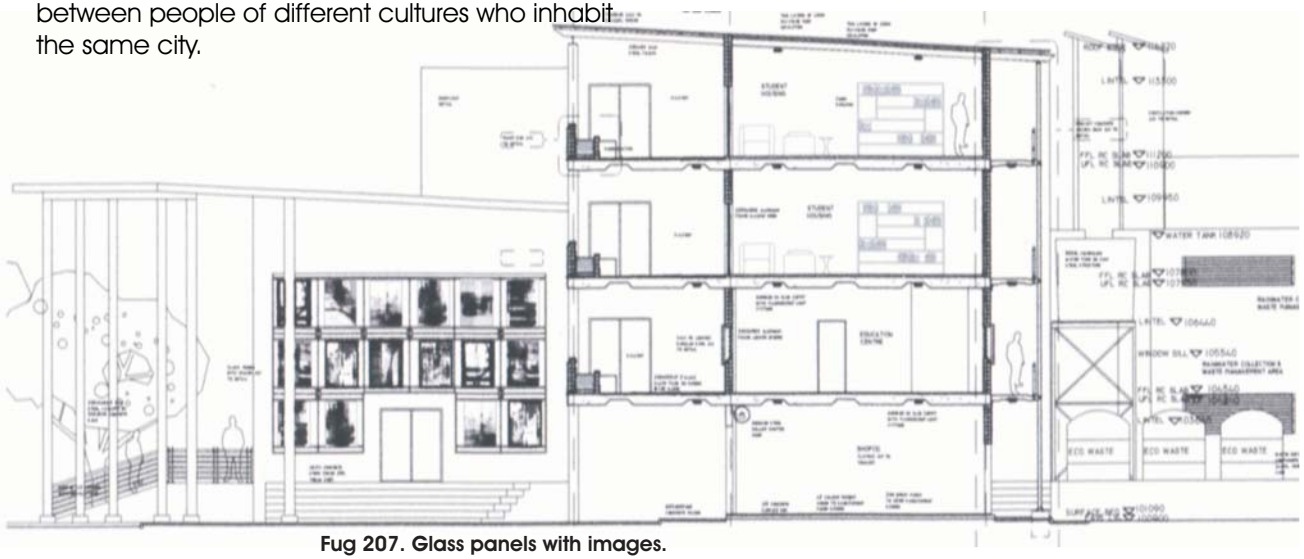
This concept of treating building surfaces as canvases was extended to the glass facades in the new building. Glass panels (1.6m x 1.3m) contain sections of printed canvases, displaying images towards the outside and inside of the building. These panels containing the images are removable to change the contents. Mosaics are used throughout the building.

"We repudiate so-called easel art and all such art which springs from ultra-intellectual circles, for it is essentially aristocratic. We hail the monumental expression of art because such art is public property." (Lipman, 2003:39)

This display of public art is a small step in healing a decayed city. It might not resolve real problems in the city like poverty, but it gives visibility to pressing communal issues. The displays serve as a medium of communication between people of different cultures who inhabit the same city.

Fig 206. Art works displayed on buildings in the city.

Fig 205. The Turbine Hall dressed in canvas.



Fug 207. Glass panels with images.

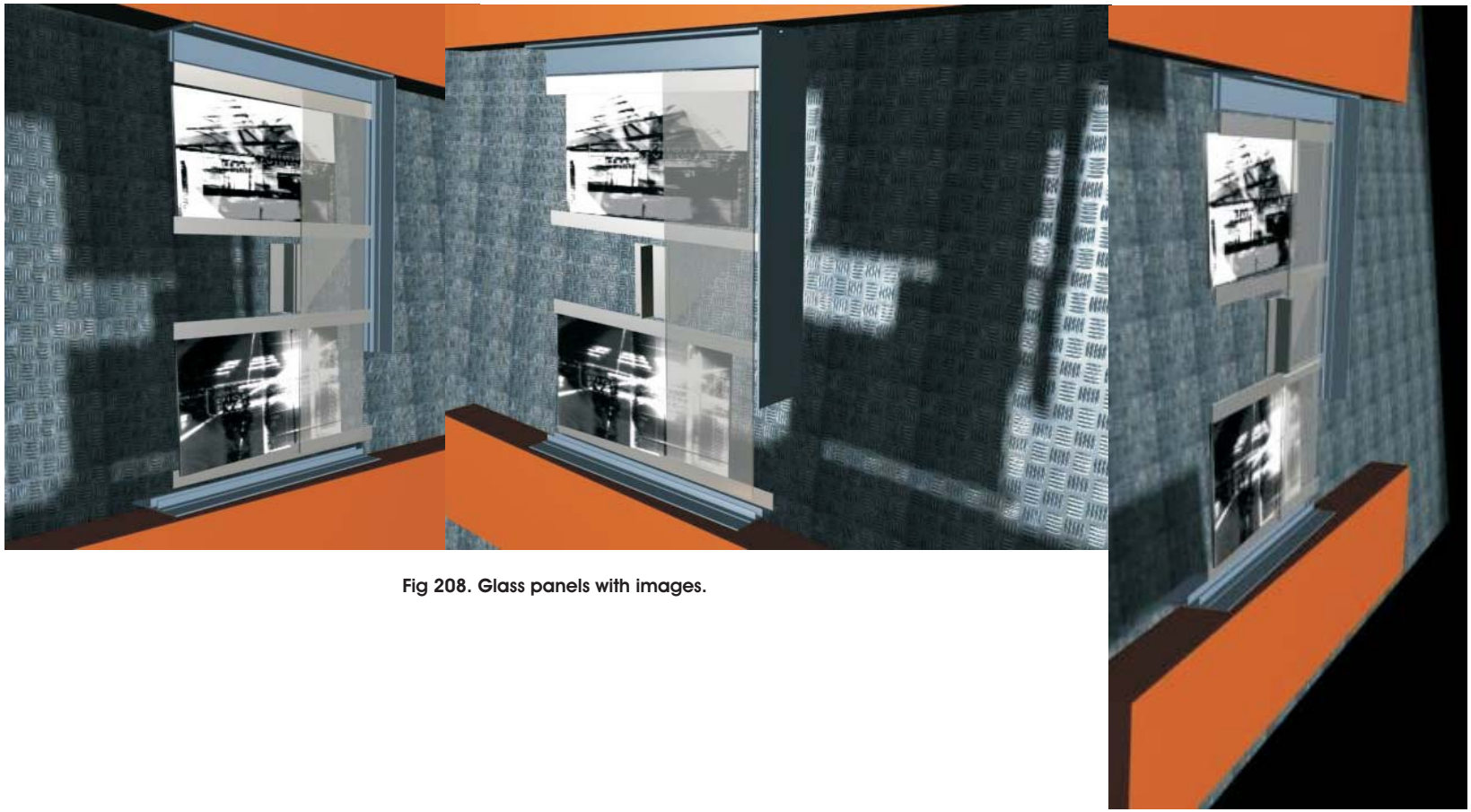


Fig 208. Glass panels with images.

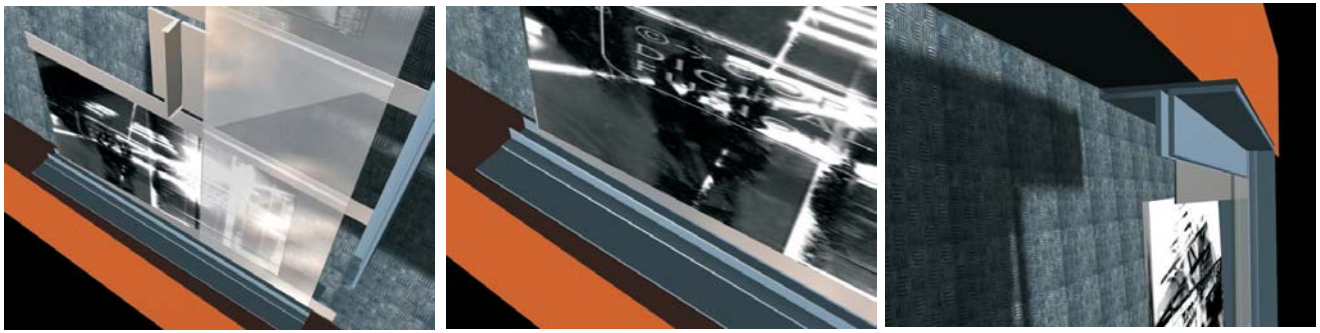


Fig 209. Glass panels: details.

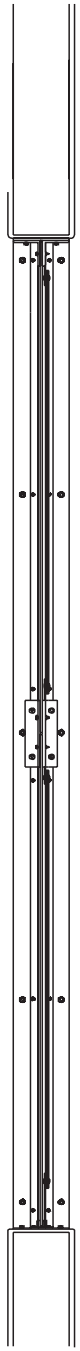


Fig 210. Section through glass panel.

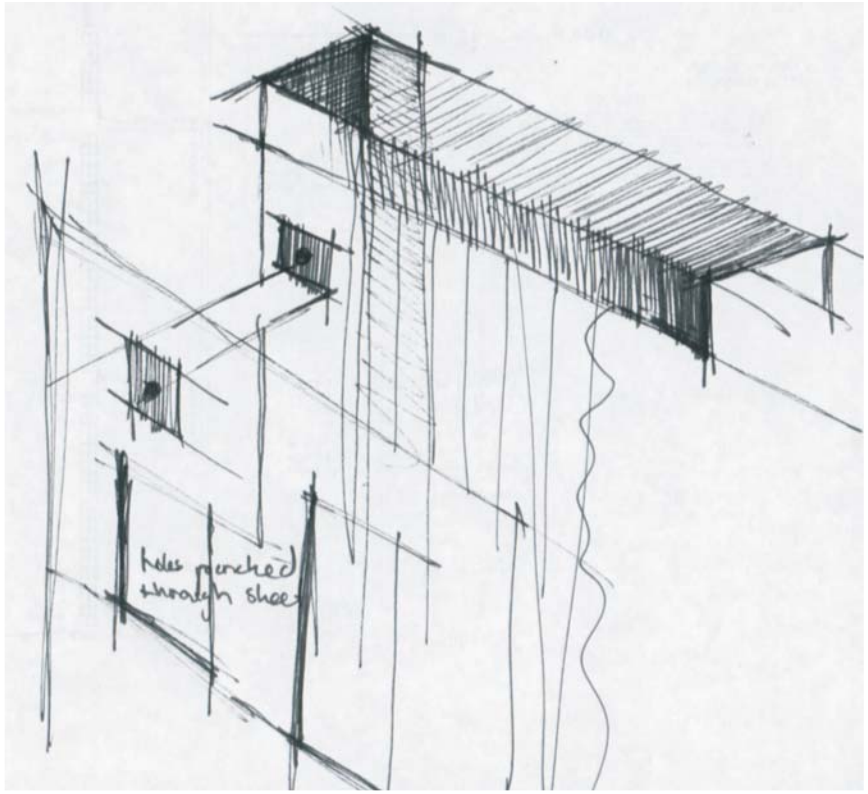
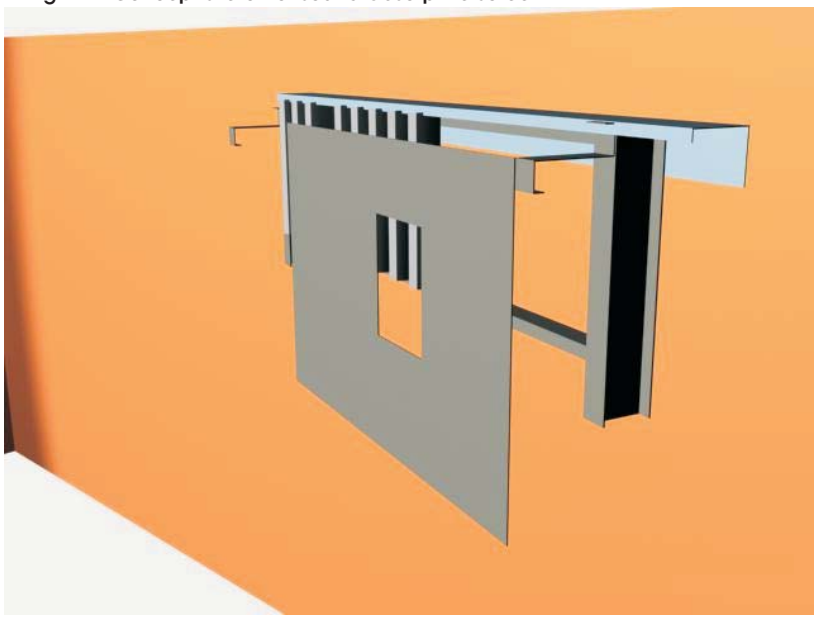


Fig 211. Concept sketch of sound-absorptive screen.



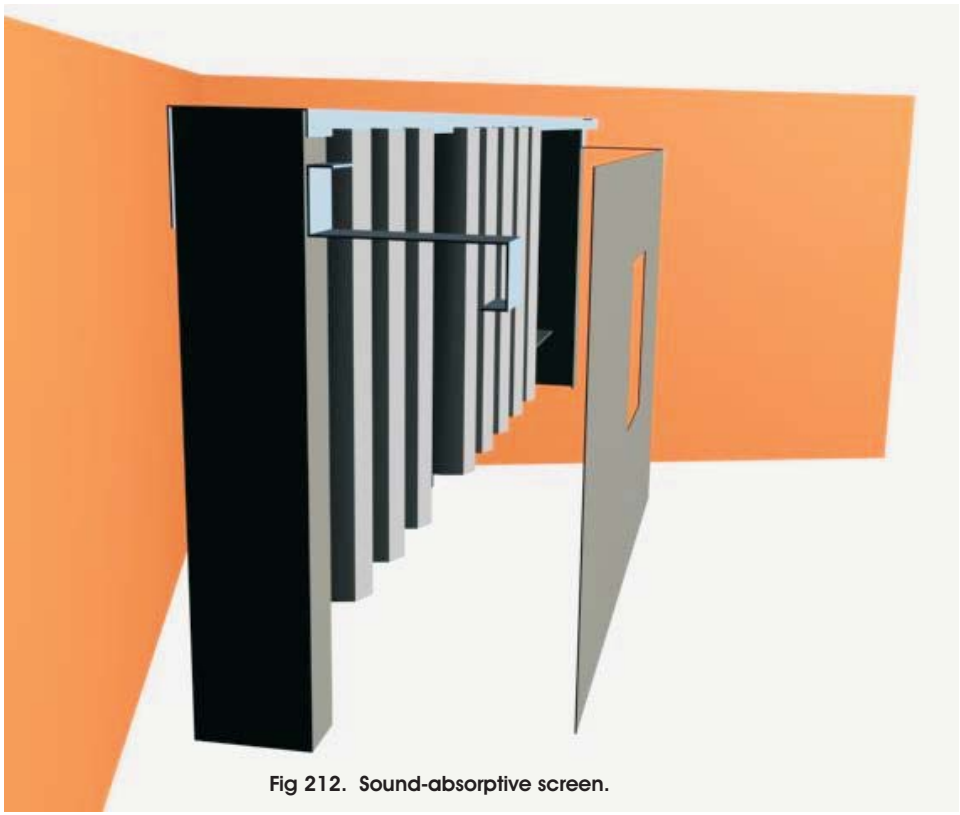


Fig 212. Sound-absorptive screen.

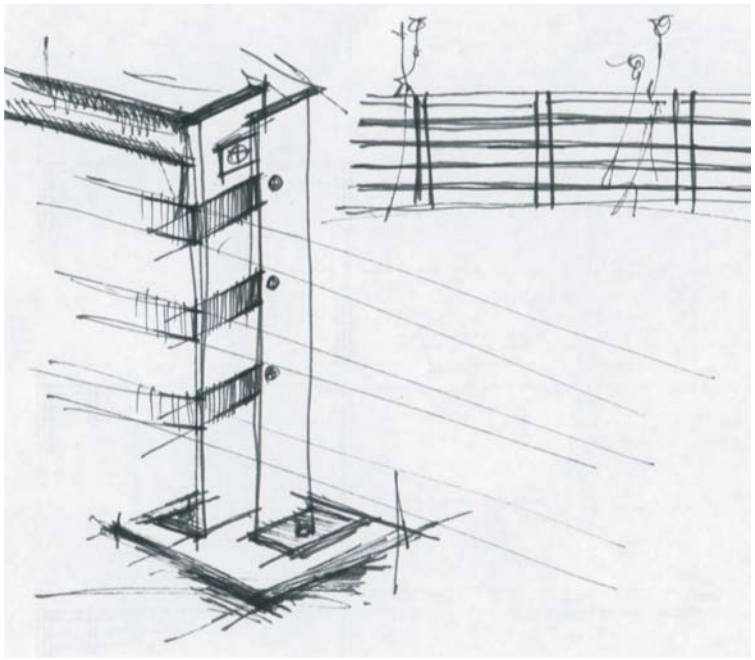


Fig 213. Concept sketch of balustrade.

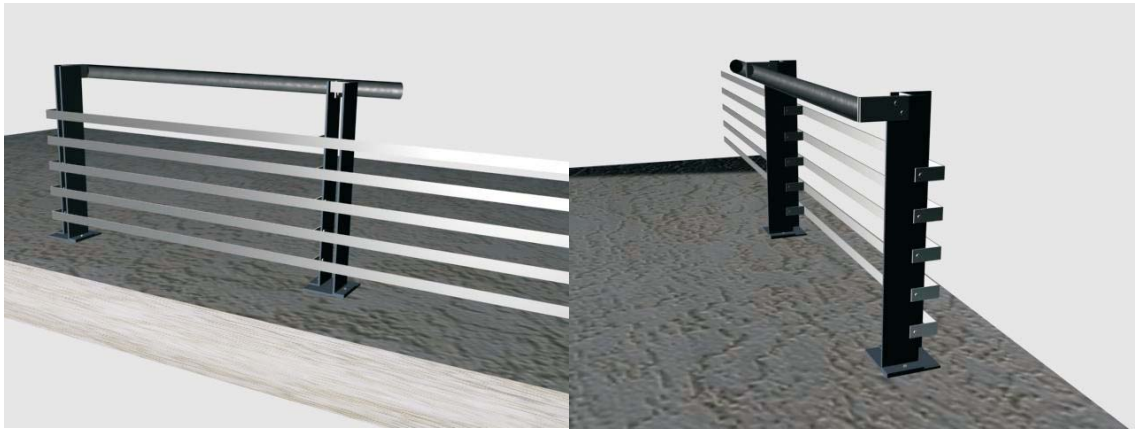


Fig 214. Steel balustrade.

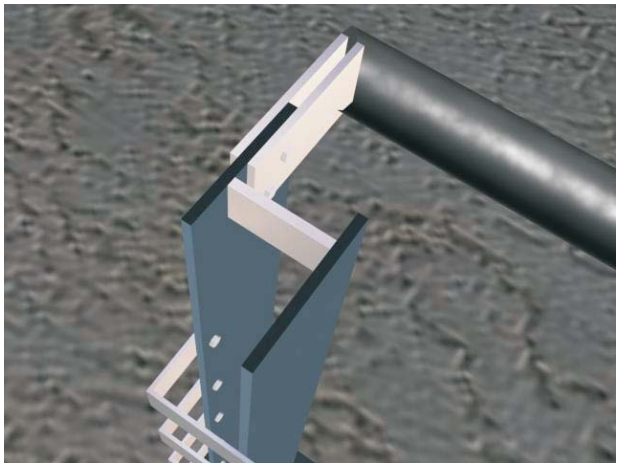
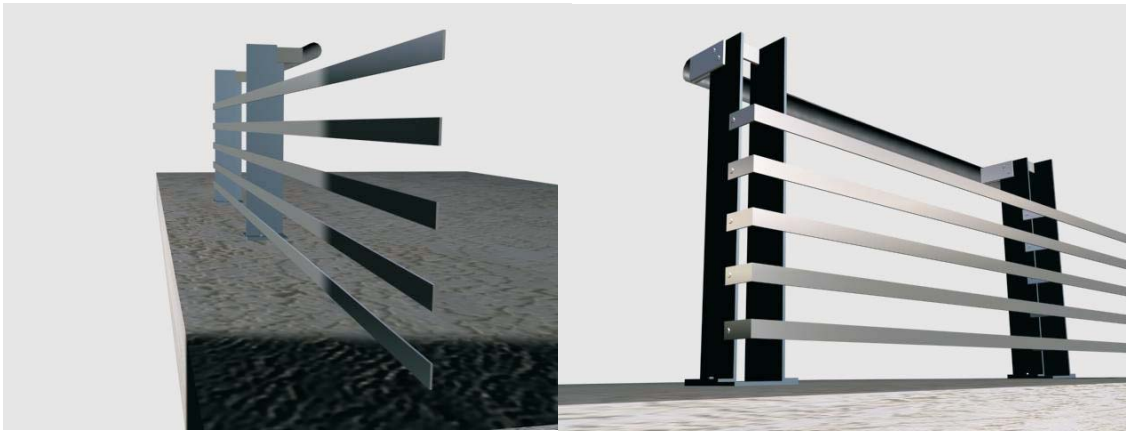


Fig 215. Balustrade: details.



Introduction:

"The surviving organism is fit for the environment" (Scott,1998:15)

Charles Darwin fully understood the relationship between an organism and its environment where every organism or system finds the fittest of all available environments, adapts that environment, and adapts itself to accomplish a better sustained relationship between them. There will always be a need for improving this adaption, because environments change and evolve and the organism has to adapt to the new circumstances to maintain a comfort level.

A building can be seen as an organism within a specific environment. A building is an organism that contains changeable systems within it that need to adapt to suit the changing environment the best. The fittest environment provides the things needed by the organism to achieve a certain level of health. (Scott,1998:22) The environment provides light, natural ventilation and renewable resources to be harnessed. These elements of nature of nature can be integrated into the design of a building to make buildings that are more responsive to the environment and its users, provide more humane places to inhibit, balance energy flows better, and which are more respectful to nature and our resources. Such a building can be seen as a healthy building.

The World Health Organization defines health as someone able to "seek and solve problems" or to recover from "insult or assault". (Scott, 1998:16) A building can be designed which responds to climatic conditions to solve problems like overheating during summer months by means of adequate natural ventilation and solar protection. By means of environmental design a building can recover from a state of user discomfort by harnessing the microclimate to create comfortable spaces for inhabitants. A building needs to have the ability to adapt to its environment. Therein lies success.

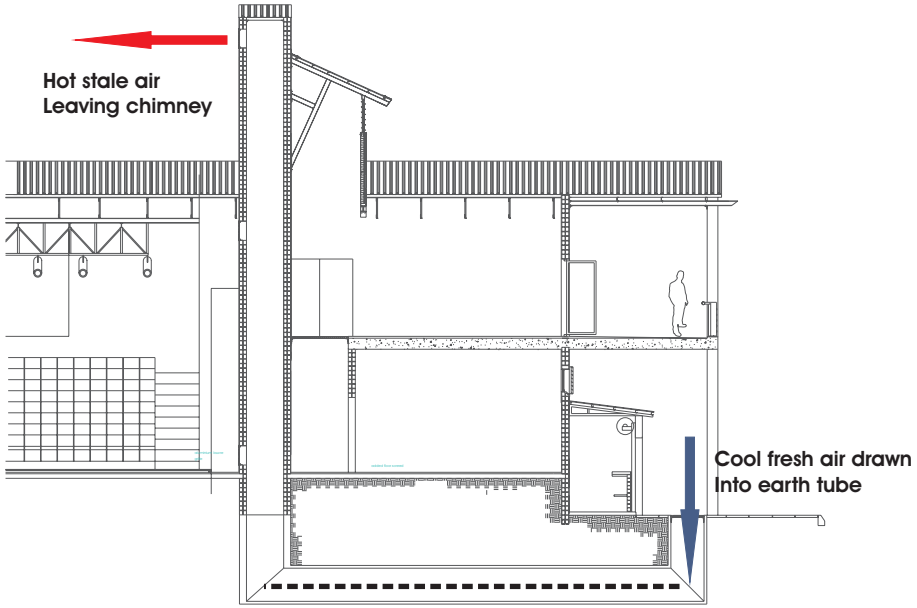
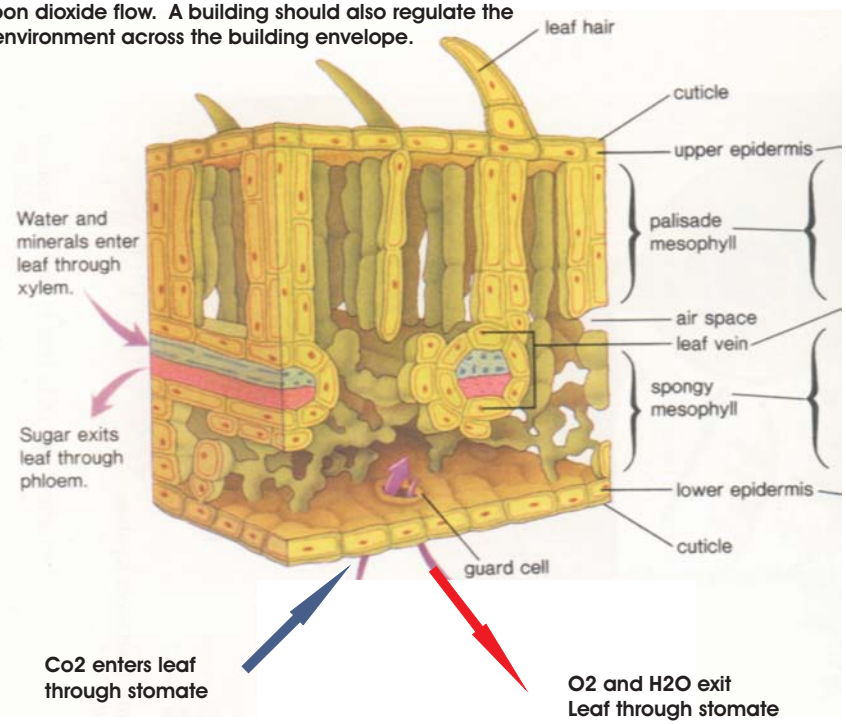


Fig 215. Section of the building showing natural ventilation through the stack effect.

Fig 216. Structure of the section of a leave to show oxygen and carbon dioxide flow. A building should also regulate the internal environment across the building envelope.



Designers of buildings need to engage in a process of adaption. We need to design systems that have gone from instability to dynamic equilibrium. A higher level of symbioses with nature has to be achieved. The building as a living organism does not stand in isolation to its environment. The chameleon is a creature that adapts to its environment, summer to winter, and to different forms of local environments woody to jungle or whatever. Buildings should be adaptable as well. A building should change according to season, and between day and night, and between different uses. An intelligent skin of such a building must regulate energy flow through itself whether it is in to out, or out to in, and store any excess energy for later use. This energy can later be redistributed to other spaces in the building where it is needed.

Designers of buildings need to engage in a process of adaption. We need to design systems that have gone from instability to dynamic equilibrium. A higher level of symbioses with nature has to be achieved. The building as a living organism does not stand in isolation to its environment. The chameleon is a creature that adapts to its environment, summer to winter, and to different forms of local environments woody to jungle or whatever. Buildings should be adaptable as well. A building should change according to season, and between day and night, and between different uses. An intelligent skin of such a building must regulate energy flow through itself whether it is in to out, or out to in, and store any excess energy for later use. This energy can later be redistributed to other spaces in the building where it is needed.

To achieve sustainability, we have to diverse our buildings as lifeless isolated objects in the environment to breathing adaptable organisms. Designers must learn from nature and ecology. The basic principles of the eco-system can be applied to building design and usage: resources must be chosen carefully, efficiently put to use, and reused and recycled again. In nature there is no garbage.

Integration with nature should be our goal. To be able to do this you have to know the local situation and understand the "genus loci". Each and every aspect of a design has to be planned. This is a difficult task but necessary if we want a sustainable development. We have to develop an urban ecology and an ecological economy to get a sustainable future. Sustainable design does not only include technical barriers, but social, economical and political problems as well. To create an ecologically sound society we have to look at these basic principles of a society.

Social issues:

Occupant comfort:

The basis of occupant comfort in the design of an internal space is the combination of two primary elements: the external climatic conditions and the demands placed upon the internal climate by the activity that will be taking place within the space. The outer walls, floor, and roof of building acts as the barriers between this internal and external climates and the interaction, which occurs between them. A two-way flow of energy occurs across this barrier. This is where the flow of energy needs to be controlled by appropriate design of this envelope to fluctuate due to variations in the environmental conditions. The barrier can utilize external environmental conditions at times or inhibit its intrusion at other times. The design of the barrier can only be in a stable state when the internal and external conditions are equal. The manipulation of external conditions for either ventilation, heating, or cooling could allow for less energy expenditure. Conventional design ignores the biological potentials that the surroundings offer them.

Besides being aesthetically pleasing, the human environment must provide light, air and thermal comfort. Proper acoustics and hygiene are also important. Human's productivity does vary accordingly to the conditions in their immediate environment. Benefits associated with improvements in thermal environment and lighting quality include:

- increased attentiveness and fewer errors;
- increased productivity and improved quality and services;
- lower rates of absenteeism and employee turnover;
- fewer accidents;
- reduced health hazards such as respiratory illnesses. (Bradshaw, 1993:9)

Comfort is best described as the absence of discomfort. Comfortable occupant conditions do not cause unpleasant sensations of temperature, drafts or humidity. Thermal comfort is a state of mind that is satisfied with the environment and is achieved through thermal control.

The factors that determine occupant comfort include:

- temperature of the surrounding air;
- radiant temperatures of surrounding surfaces;
- humidity of the air;
- air motion;
- odors;
- dust;
- acoustics;
- lighting;
- aesthetics.

There are three basic ways in which a living organism responds to its immediate environment: migration, form and metabolism. During migration animals like birds move from a cold environment to a warmer environment. Animals have large or small skin areas in relation to their volume to increase or decrease their rate of heat loss to the environment. An example is the enlarged surface area of an elephant's ears that radiate heat. Metabolism requires energy from food and the result is the production of heat. Animals with a high heat loss eat large amounts of food to balance their heat loss in their environment. These three forms of thermal response have their analogies in buildings. Migration: occupants can move from one area in a building to a more thermally comfortable area. The form of a building dictates the building's response to the environment: size, shape, exposed are, orientation, volume and openings influence the building's conditions.

Metabolism, the sustained processes of a building, must be concerned with maintaining the thermal equilibrium. Metabolic rate is a function of how well the form uses available energies to modify climate.

Metabolism:

Thermal comfort is a function of the physical environment plus the activity and clothing level of a person. People can adapt their clothing levels, activity levels and posture in response to thermal conditions. People metabolize the food they have taken into their bodies and convert it to electrochemical energy. This energy is used for growth, regeneration and operation of the body. When energy is converted from one form to another, heat is formed as a by-product of the conversion. The result is the generation of heat within the body, which needs to be rejected by means of sensible heat flow (radiation, convection or conduction) to the environment. As the need for energy increases, metabolism increases, and also the production of body heat.

To determine the desired environmental conditions for comfort, this metabolic level during certain activities needs to be taken into account. Metabolic rate is measured in *met* units. 1 *met* = 58.2 W/m (Bradshaw, 1993:20) For an average sized man the *met* unit corresponds to approximately 100 W. In table 1.1 the metabolic rate is given for different typical activities. Dancing has a *met* value of 2.4 - 4.4. This is a rather high metabolic rate. This activity will take place in studios and on stage. Adequate ventilation must be provided to remove this metabolic heat from a space.

Clothing of occupants:

Clothing determines thermal comfort. Clothes regulate body heat loss. Clothing has good insulative properties. Clothing insulation can be best described in terms of its *clo value. Clo* value is a numerical representation of a clothing ensemble's thermal resistance.

1 *clo* = 0.155 m .C/W (Bradshaw, 1993:21)

Clothing worn by Johannesburg occupants is rated between 0.5 and 1.5 *clo*. 1 *clo* = lightweight summers clothing. A dancer will wear clothing with a value of approximately 0.47 - 0.5 clo, seeing that their bodies generate more heat during dancing. Seasonal clothing variations of occupants allow indoor temperatures to be higher in the summer than in winter and yet remain comfortable. During winter additional clothing lowers the temperature necessary for comfort. Adding 1 *clo* of insulation permits a reduction in temperature of approximately 7.2 C without compensating comfort.

Elements that effects occupant comfort:

Air temperature represents the temperature as read by the common thermometer and affects the rate of convection and evaporation of body heat. This is also known as the dry-bulb temperature. This is the most important determinant of thermal comfort. Absolute humidity is the amount of water by weight in the air. The amount of moisture that air can hold is a function of the temperature: the warmer the air, the more moisture can it hold. Relative humidity is the ratio of the actual vapor pressure of the air-vapor mixture to the pressure of saturated vapor at the same dry-bulb temperature times hundred. Mean radiant temperature is a weighted average of all radiating surface temperatures within line of sight. Mean radiant temperature affects the rate of radiant heat loss from the human body.

$$MRT = \frac{\Sigma T.\theta}{360}$$

$$MRT = \frac{T1\theta1 + T2\theta2 + \ldots\ldots Tn\theta n}{360}$$

T = surface temperature
è= surface exposed angle relative to occupant in degrees

During winter:

T1 = 9°C T2 = 16°C T3 = 22°C
θ1 = 74° θ2 = 106°

The MRT for the occupant = (9.74) + (16.74) + 2(22.106)
= 18°C

A MRT of 18 - 27°C is still acceptable (Bradshaw, 1993:27). Solar radiation during winter can increase the inside temperature.

During summer:

T1 = 20°C T2 = 24°C T3 = 33°C
θ1 = 74° θ2 = 106°

The MRT for the occupant = (20.74) + (24.74) + 2(33.106)
= 28°C

With adequate natural cross ventilation a lower inside temperature can be achieved.

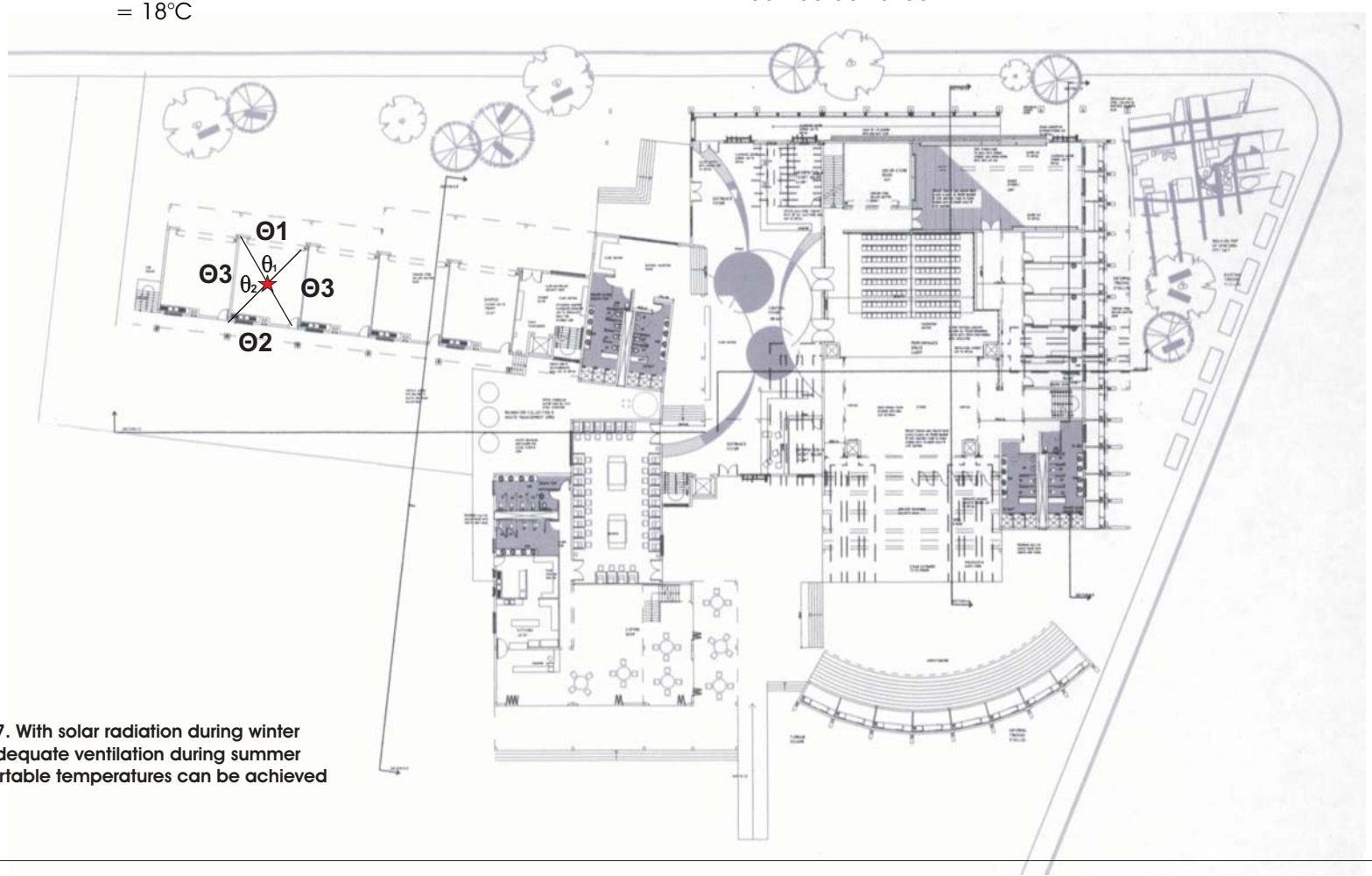


Fig 217. With solar radiation during winter and adequate ventilation during summer comfortable temperatures can be achieved

Air movement affects body heat transfer by convection and evaporation. Air movement is the result of natural or forced convection. Natural convection of air over skin allows for continuous loss of body heat. Insufficient air movement promotes stuffiness and air stratification. Unpleasant drafts are experienced when air motion is too rapid.

The psychometric chart is a graphic presentation of the condition of the air at a given location, relating temperature to moisture. The chart also expresses the energy content of the air. This total air energy is the sum of both the temperature content of the air and the vaporized moisture content of the air.

The ideal design conditions for comfort are:

- when altitudes are from sea level to 2134m;
- mean radiant temperature is nearly equal to dry-bulb temperature;
- relative humidity is 40% (20 60% range)
- air velocity is less than 0.2 m/s

There is no minimum air movement necessary for thermal comfort within the comfort envelope on the chart. The maximum allowable air motion is lower in winter than in summer. In winter, the average air movement within the occupied zone should not exceed 0.15 m/s (Bradshaw, 1993:31) In summer, the average air movement in the occupied zone can go as high as 0.25 m/s under standard temperature and humidity conditions. Above 26 C comfort can be maintained by increasing the average air motion 0.275 m/s for each 1 C of increased air temperature up to a maximum of 0.8 m/s (Bradshaw, 1993:31). At this point, loose paper, hair and light objects start blowing around.

If activity increases above the 1.2 *met* level, sweating increases. To maintain comfort, clothing has to be adjusted, the air motion must be increased or the temperature must be decreased. When one of these conditions is out of the comfort range, adjusting one or more of the other conditions will restore comfort with little or no additional energy.

The design and construction of a comfortable, energy-efficient building depends upon the prevailing climatic conditions. In Johannesburg summers are warm to hot with the highest recorded temperature 35 C during January and the coldest temperature was 5 C during June. The air is fairly dry: about 30% humidity.

When the temperature and humidity conditions of a quantity of air is known, it is possible to find out the amount of energy (in Btu/lb or kj/kg) needed to be added or extracted from the air to obtain some other desired condition.

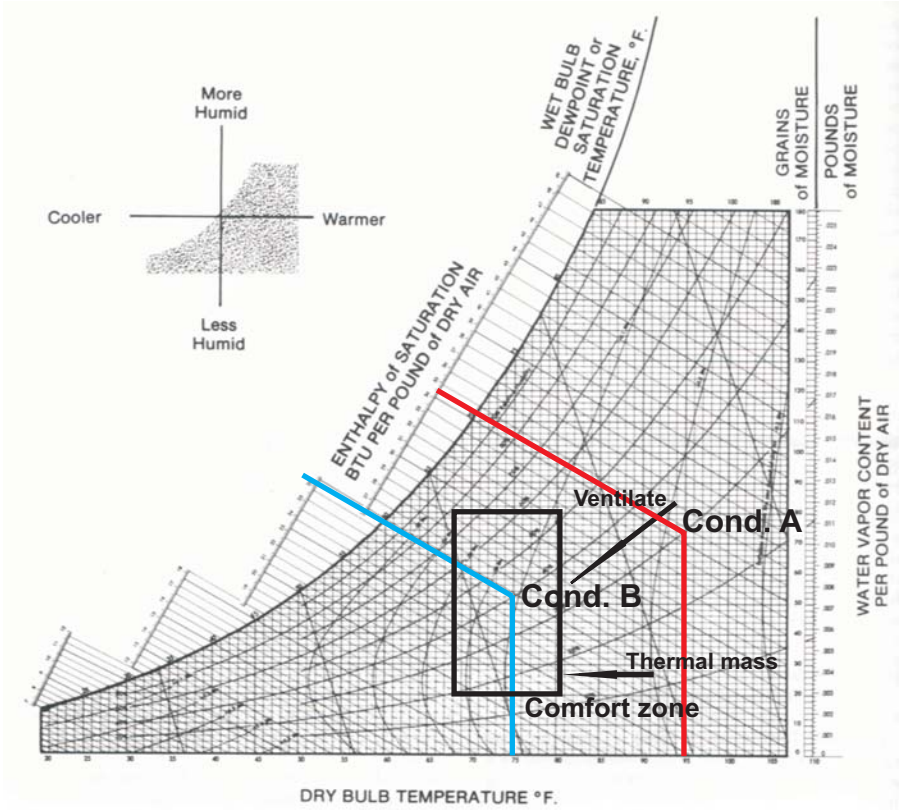


Fig 218. Psychometric chart during summer.

Condition A (outside temperature): 35 C (95 F) and 30% humidity
Condition B (desired temperature inside): 24 C (75.2 F) and 40% humidity

The netto energy difference is the enthalpy of A minus the enthalpy of B. The amount of heat that must be removed is 35 Btu/lb 27 Btu/lb = 8 Btu/lb = 18.6 kj/kg.

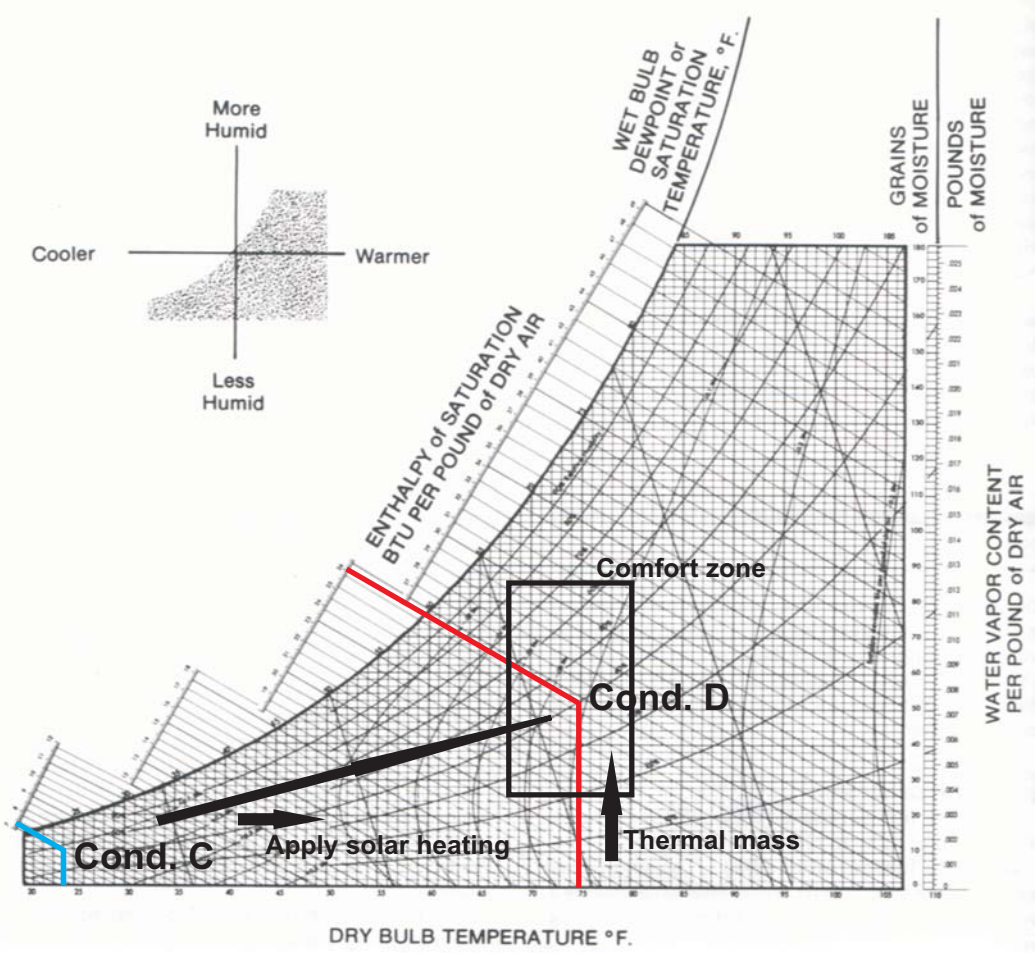


Fig 219. Psychometric chart during winter.

Condition C (outside temperature): -5 C (23 F) and 30% humidity
Condition D (desired temperature inside): 24 C (75.2 F) and 40% humidity

The amount of heat required is 27 Btu/lb 7 Btu/lb = 20 Btu/lb = 46.52 kj/kg

The conditions within Johannesburg's macroclimate show that a reasonable building would offer a fair level of comfortability, with a bearable heat load in summer while some additional heating would be required during winter.

Natural lighting:

Sunlight, direct and diffused, has the potential to save electrical energy by reducing the demand for artificial lighting. Daylight illumination depends on how much sky is visible from the point in question. The luminous flux (lumen) is used in practice for the design of lighting. It is the flow or amount of light from a light source, emitted through a solid angle. Sunlight is a highly efficient source of illumination, making it a comparatively cool source. On a bright day, sunlight can produce levels of illumination 50 times as high as those recommended for artificial illumination. It provides approximately 90 to 120 lumens of illumination per watt of total energy, compared to 40 to 75 lumens per watt for common fluorescent and 15 to 25 lumens per watt for incandescent light (Bradshaw,1993: 283). Electrical light introduces about twice as much heat per unit of light into a space as does daylight. Large areas of glazing introduce increased daylight into spaces, but can affect the amount of energy needed to heat or cool a space. Efficient shading from direct sunlight can prevent heat gain during summer. Heat losses during winter can be minimized by double glazing, insulation and operable thermal barriers for use during non-daylight hours.

Latitude, time of the year, air pollution levels, humidity, landscaping and nearby buildings determine daylight conditions. There is more sunlight during winter than in summer. The duration of bright sunshine exceeds 80% in winter and 60% in summer in Johannesburg. Day lighting affects the amount of fenestration into a building, the appearance of it on the façade, the building shape and the building's orientation.

Daylight must meet the same visual performance criteria as artificial lighting in providing adequate levels and quality of task illumination. Although daylight cannot be used all the time, even a building, which is used, round-the-clock can use daylight for a few hours during the day and thereby reducing the lighting energy consumption. Indirect sunlight provides illumination levels that are 10 20% as bright as direct sunlight. When the sky i overcast, the daylight is diffuse, coming from all directions, including ground reflection. This is still more light than is needed, so a daylight system can be very useful.

JOHANNESBURG & PRETORIA Latitude (nearest) 26° South
Both cities taken as longitude 25.5°E (Add 4.5° or 18 minutes to solar time)

Solar times		*06.00*	*08.00*	*10.00*	*12.00*	*14.00*	*16.00*	*18.00*
Clock times		06.18	08.18	10.18	12.18	14.18	16.18	18.18
Azimuth	21/12	112E	101E	91E	0	91W	101W	112W
Altitude	21/12	10	35	63	88	63	35	10
Azimuth	21/3 & 9	90E	76E	53E	0	53W	76W	90W
Altitude	21/3 & 9	0	26	51	65	51	26	0
Azimuth	21/6	-	55E	34E	0	34W	55W	-
Altitude	21/6	-	14	32	40	32	14	-

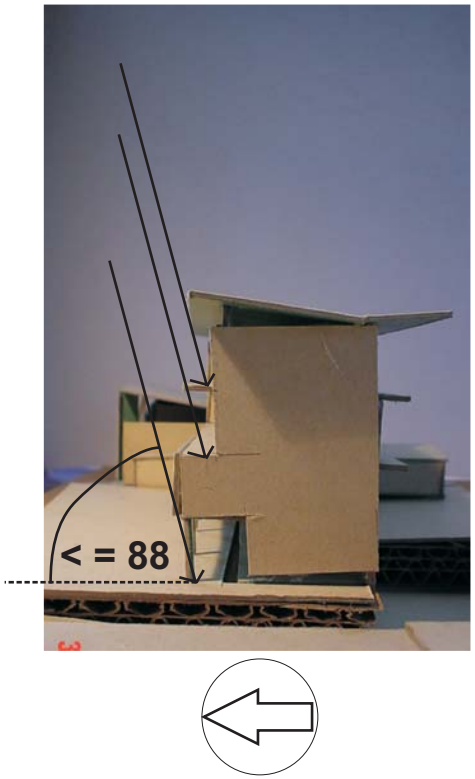


Fig 220. Indirect sunlight must be avoided during summer to prevent heat gain.

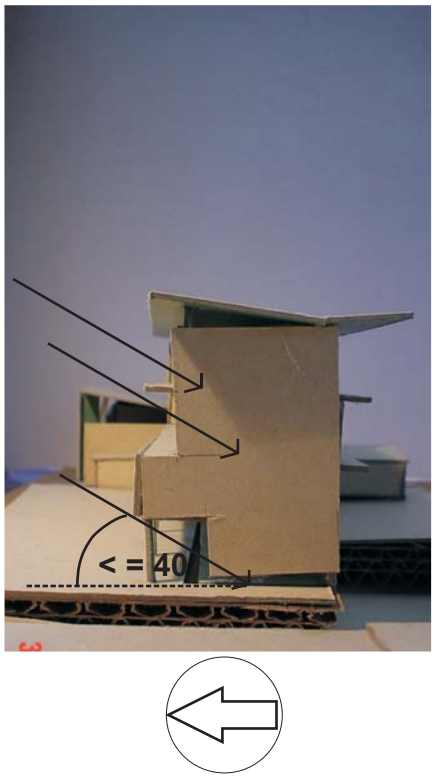


Fig 221. During winter direct sunlight must be admitted to interior spaces for direct heat gain.

Fenestration for daylighting may be trough the roof and are identified as top lighting. Side lighting is vertical windows. Top lighting are more effective than side lighting because the quantity of light from the sky is greater than that reflected by the landscape. Lighting from above is most useful in areas where light is needed but visual contact with the outdoors is not. This method distributes illumination more uniformly to all the walls. Clerestory windows, when orientated northwards, can maximize solar heat gain during winter. A roof light provides natural lighting right through to the circulation space next to the dressing rooms. A mentis grid walkway lets light through the first floor level to the ground floor. The walkway next to the studio situated over the stage receives natural lighting through polycarbonate roof sheeting. Overhangs minimize solar heat gain in the cooler season. South-facing windows are appropriate if heat is not needed. They provide a steady light level. South facing windows are used in this dance studio. Placing the top of windows as near to the ceiling as possible allows the light to reflect of the ceiling for optimum indirect lighting effects. The central atrium receives daylight through large openable glass surfaces covered with movable aluminium louvres. This space also receives filtered natural light through the printed fabric-covered glass panels at the northern entrance.

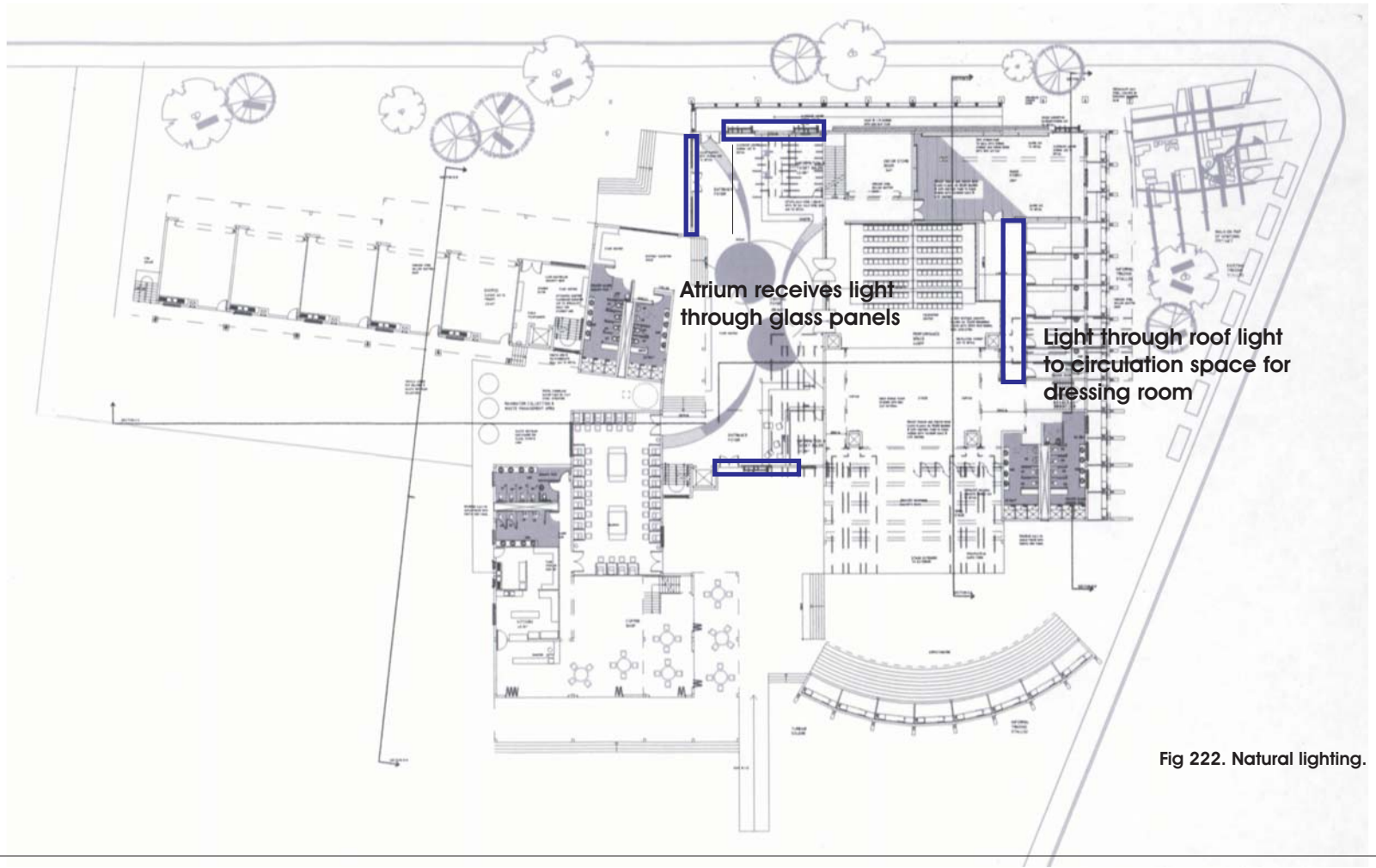


Fig 222. Natural lighting.

Fig 223. Rooflight

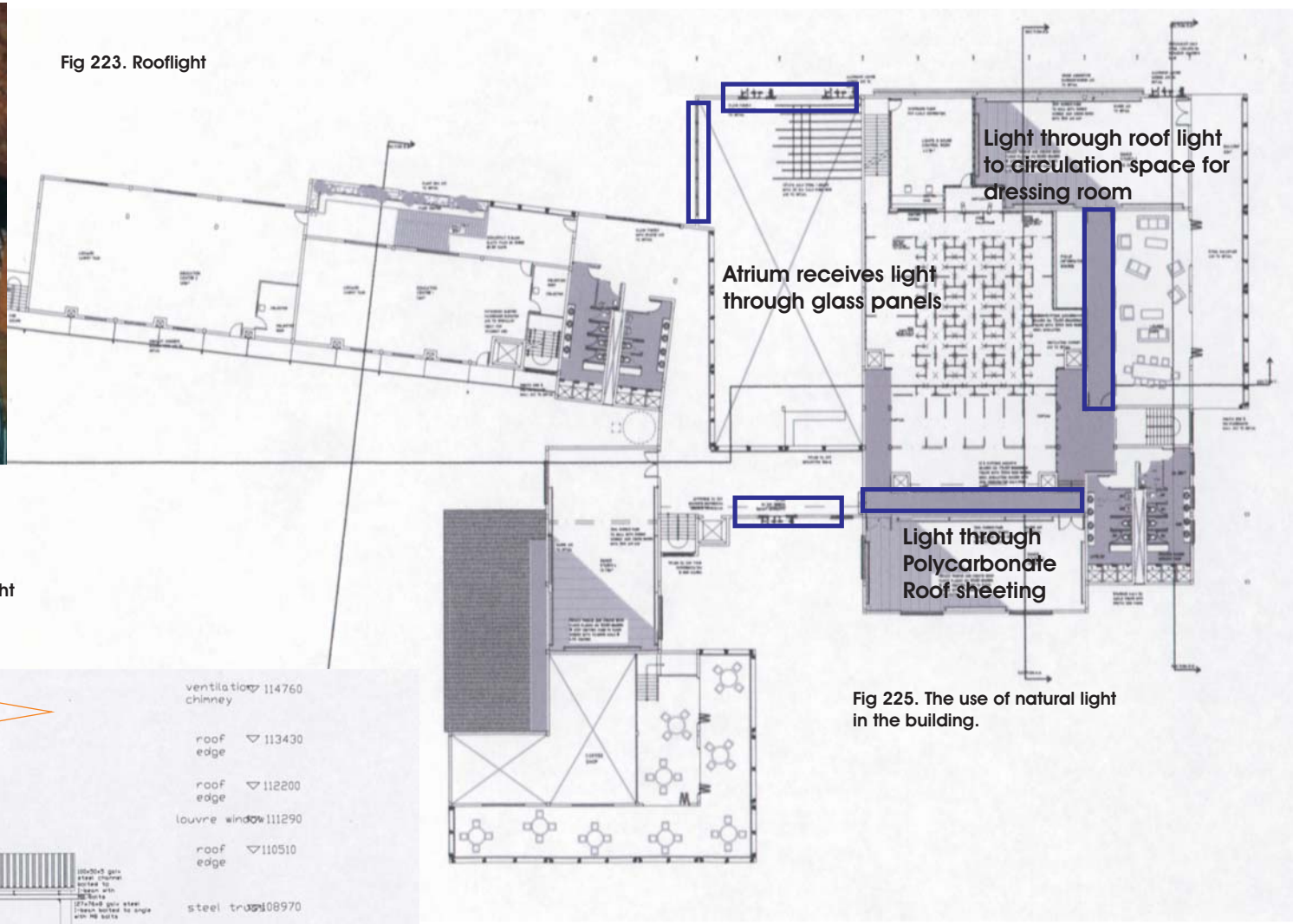


Fig 225. The use of natural light in the building.

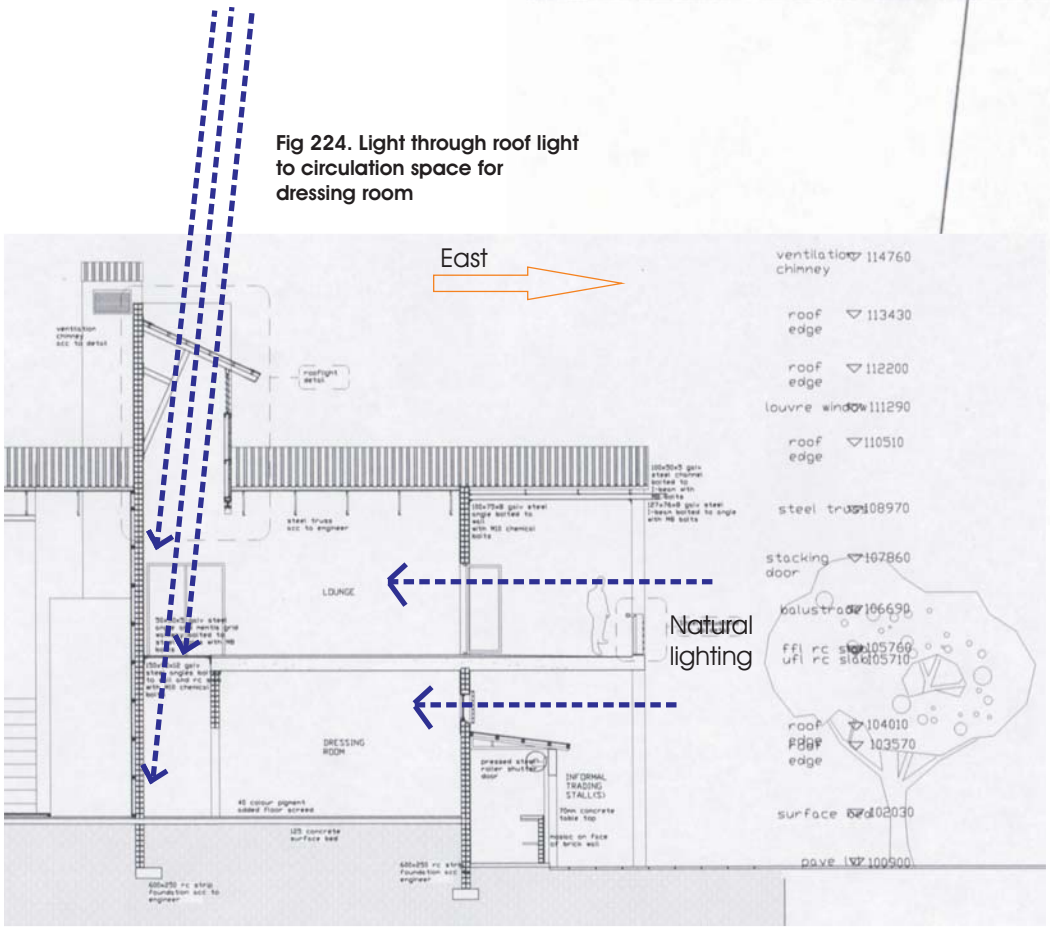


Fig 224. Light through roof light to circulation space for dressing room

Light control devices like movable aluminium louvre screens are used to Balance light patterns and distribute daylight throughout a space. They also provide privacy when required. Other exterior light control include louvres in front of windows. These louvres also function as burglar bars for security. An overhang decreases light levels near the window that makes light levels more uniform throughout a space.

Artificial lighting:

Artificial lighting includes the use of fluorescent lamps rather than incandescent lamps. Fluorescent lamps are more efficient than incandescent lamps and have up to 20 times longer life than incandescent lamps. More light is emitted by a 40-watt fluorescent tube than by a 100-watt incandescent bulb. The efficacy of fluorescent lamps depends on their color-rendering capabilities. The most efficient are warm white, cool white and white. These are best where economical light production is important. Deluxe warm white and deluxe cool white can be used where lower efficacies are acceptable. The lamp life of a fluorescent tube is dependant on the number of starts. The lumen output of a fluorescent lamp deteriorates rapidly during the first 100 hours of burning and thereafter much more slowly. The figures in table yy presents output after 100 hours of burning. At 40% of a bulb's average rated life, its output drops to approximately 85 90% of the 100-hour initial value. Fluorescent light have a life on average of 10 000 hours whereas incandescent light only offers 1000 hours. Fluorescent tubes give off far less heat than incandescent bulbs.

The shape of fluorescent lamps are tubular and straight. The standard 1.2 m tube is rated 40 watts. Energy-conserving reduced wattage lamps are available to decrease power consumption. A comparison between the wattages of a standard and energy-conserving 1.2 m and 2.4 m lamps are presented in Fig 20. The light output of the energy-conserving lamp is lower. The life of a 2.4 m lamp is shorter.

Fluorescent lamps are also available in U-shape for use in a 60 cm square fixture. The U-lamp is a standard 40-watt, 1.2 m fluorescent tube bent into this shape. Another fluorescent lamp light is a lamp that fits into an ordinary incandescent socket. The lamp uses 44 watts of power, but produces as much light as a 100-watt incandescent bulb (Bradshaw, 1993:270).

Lamp	Power Consumption (Wattage Range)	Rated Initial Lumens/Watt (Incl. Ballast)	Average Rated Life (hours)[a]
Incandescent			
Standard	10–1,500	15–25	750–3,500
Tungsten halogen	100–1,500	15–25	2,000–12,000
Fluorescent			
Standard	15–100	40–95	9,000–20,000+
High-output	60–215	45–100	9,000–20,000+
High-intensity discharge (H.I.D.)			
Mercury vapor (standard)	40–1,000	24–60	12,000–24,000+
Mercury vapor (self-ballasted)	160–1,250	14–30	10,000–20,000
Metal halide	175–1,500	69–115	7,500–20,000
High-pressure sodium	35–1,000	51–130	12,000–24,000+
Low-pressure sodium	18–180	62–150	12,000–18,000

Fig 226. Fluorescent lights compared to incandescent bulbs.

Stage lighting:

There are a few factors governing the positions of lighting. There needs to be easy access to the lights. The access needs to be to the rear of the instrument with ample room for the staff to reach around the instrument to the front and also sufficient free space for the instrument to be readily demounted for repair. Over a third of the total number of instruments in a modern rig are likely to be located in the auditorium space (more to the front). The desired angle is normally between 42 and 44 degrees at an angle to a horizontal plane emanating at the stage front (Adler, 1994: 20-20). Lanterns are required at a high angle either side as well as across the main front area of the stage. Lanterns are either housed on bridges which cross the auditorium, or attached to the building structure itself.

Many people consider lanterns and their relevant bulky cabling and paraphernalia to be unsightly in the context of a formal auditorium. However, this performance space will carry a "high tech" design ethic and it will be acceptable to place lanterns in exposed positions, provided they are sympathetically arranged as they become part of the design integrity.. Lanterns themselves must not intrude into the audience's line of sight. Safe means of suspension must be provided.

One of the selling points for a multi-functional performance space is the speed and ease with which one can move from one production to another. Frequently this is serviced by having a grid made up of 50 mm steel tubing over the whole space from which lighting instruments can be hung in any location (Adler, 1994: 20-20). The grid can be accessed from below by a mobile access system.

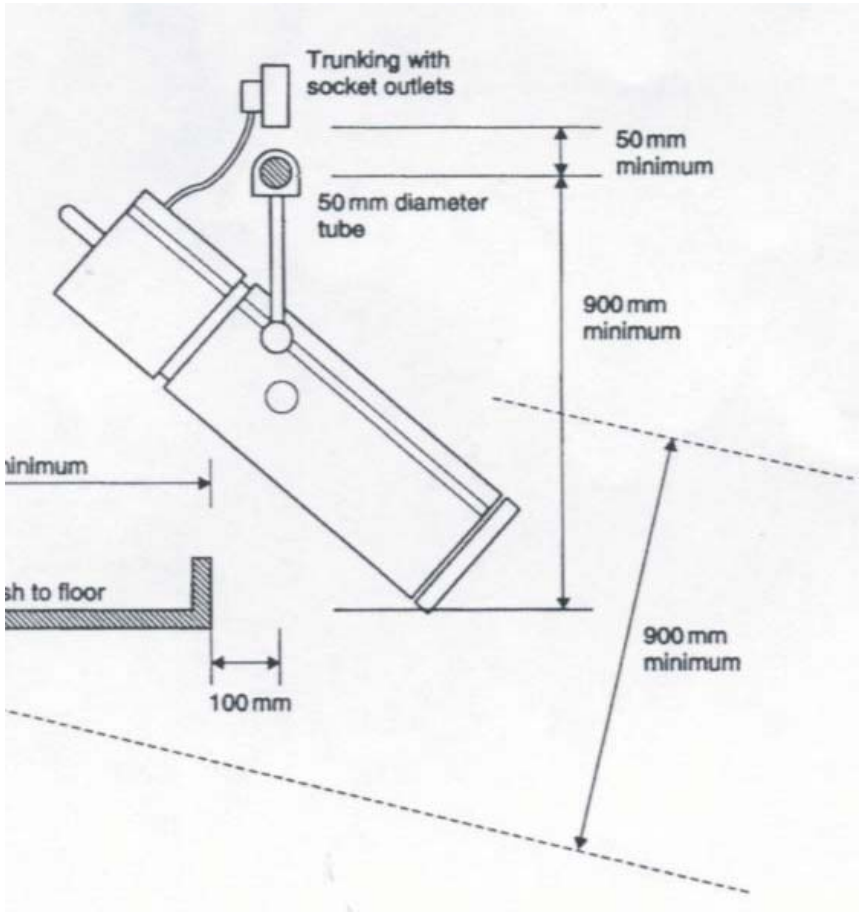


Fig 227. A lantern light which will be mounted on the lighting bridge grid.

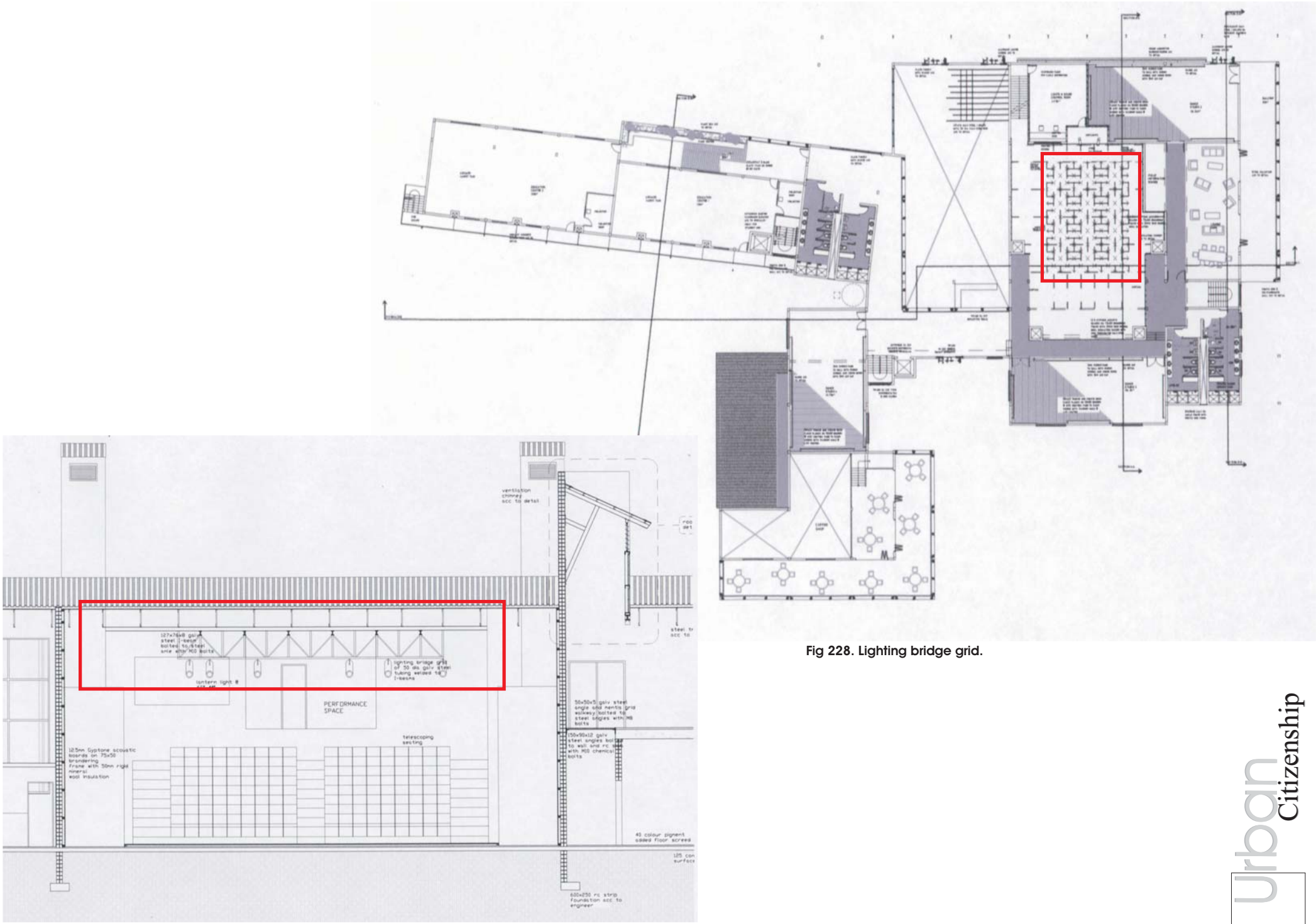


Fig 228. Lighting bridge grid.

Ventilation:

Natural ventilation is the movement of air into and out of a space through openings such as windows and doors intentionally provided for this purpose, or through non-powered ventilators. Natural ventilation provides fresh air as well as a cooling effect by replacing hot interior air with cool air outside. Prevailing wind directions can assist in the cooling of spaces. The quality of air in a space can affect occupant comfort. Under heavy occupancy of a space, the concentration of carbon dioxide can rise to unhealthy levels. Concentration of people in confined spaces, such as theatres, require the removal of carbon dioxide given of by respiration. At atmospheric pressure, oxygen concentrations of less than 12% or carbon dioxide concentration greater than 5% are dangerous. Other two major sources of low air quality are dust and tobacco smoke. Smokers and non-smokers need to be segregated in public spaces. Isolation of the smokers does not solve the problem: it only results in better dilution of the air. Two natural circulation techniques can be used:

- wind-induced cross ventilation;
- gravity ventilation.

Outdoor air ventilation requirements for various indoor spaces are given in litres per person. The ventilation rates are believed to provide a generally acceptable level of carbon dioxide, particles and odours. In bedrooms 15 l/person/room is needed. Retail stores need 1.5 l/person/square metre. Dressing rooms need 1.0 l/person/square metre. A ticket booth needs 10 l/person and an auditorium 8 l/person. A stage also needs 8 l/person. A lobby needs 10 l/person (Bradshaw, 1993:579). The ventilation rate needed to provide satisfactory air quality depends on ventilation effectiveness. Ventilation effectiveness depends on design, performance and location of supply outlet and return inlet. The supplied air needs to pass through an occupant zone before it passes out through the outlet. When spaces are unoccupied, ventilation is not required.

Natural ventilation usually occurs across operable windows. Windows may open by sliding vertically or horizontally. For cooling purposes, the outdoor stream should be directed towards where people are located. Personal manual control of openings is necessary to allow each occupant to control wind velocity and to establish occupant comfort.

Two openings are necessary for cross ventilation: one as an inlet on the windward side of a building; and the other as an outlet on the leeward side. Rooms most effectively ventilated by an inlet located near the bottom or middle of the windward wall, and an outlet in any position on the leeward wall. The inlets and outlets should be roughly the same size or the outlet can be larger. Obstacles upstream from intake openings or downstream near outlets can reduce wind velocity. Roof overhangs and the judicious location of trees can increase wind velocity at ground level and can improve air movement. For natural ventilation through operable windows, doors or louvres, the total openable area should be at least 1/25 of the floor area served. Toilets and bathrooms should have at least 0.3 m of window opening area. Air and sound are inseparable. Natural ventilation accompanies noise through an opening.

Gravity ventilation eliminates the need for window ventilation and allow for more flexibility. Gravity ventilation takes advantage of the thermal buoyancy of air. Vents at different levels in an interior space draw cool air in through a lower inlet, while forcing warm air out through the higher outlet. Ventilation chimneys will be used in the performance space, making use of the stack effect. The rate at which air circulates depends directly on the air temperature, the height difference between the two vents, and the size of the vents:

Q = 116 A sqrt H T Q = airflow rate (l/s)

A = free area of inlets/outlets, whichever is less (square m)

H = height difference between inlets/outlets (m)

T = temperature difference between incoming and outgoing air (C)

For one ventilation chimney:

A = 0.4 square m
H = 8 m
T = 30C - 21C = 9C

Q = 116 (0.4) sqrt (8.9)
= 394 l/s

An auditorium needs 8 l/p. For 190 persons it is 1520 litres needed.

For 4 ventilation chimneys = 4 (394 l/s)
= 1574 l/s.

Air inlets should be located as low as possible in areas likely to have low temperatures. Drawing air through underground passageways before it enters a building will cool the air. The vents should be clear of obstruction. Outlets should be located as high as possible and preferably in areas where wind movement can be used to create a suction effect to aid in drawing air through the building. When air is heated it expands. It becomes less dense and more buoyant than colder air. In a space with a high ceiling, air near the ceiling are less dense than air at the bottom of the space. The less dense air rises higher than the more dense air. High density cooler air on the outside of the building envelope will tend to exert pressure against the building at its base, causing infiltration. When this infiltrating air is colder than room temperature, it will be warmed by room surfaces, internal sources of heat, or solar radiation entering through fenestration. As air is warmed, it will rise and escape near the ceiling under the pressure of the warm air behind it, overcoming the lower pressure exerted against the building by the low-density surrounding air.

An induced-draft system is a special kind of a gravity ventilator. A solar chimney is used that, when heated by sunlight, created an additional updraft that pulls a breeze through the chimney. The rate of airflow is proportionally to the intensity of the solar radiation striking the darkened upper part of the chimney.

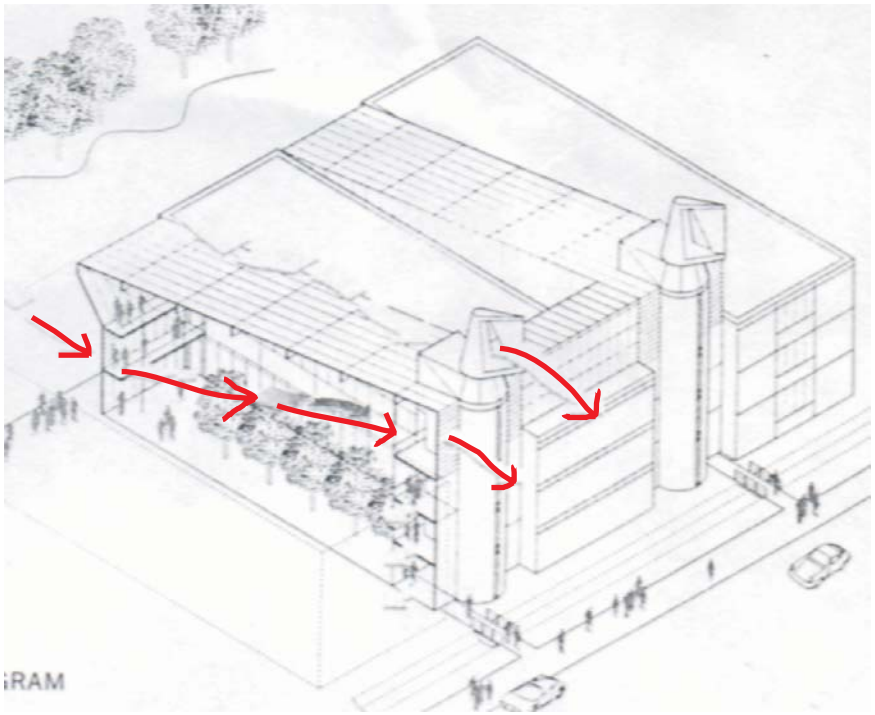


Fig 229. Ventilation chimneys used for ventilation.

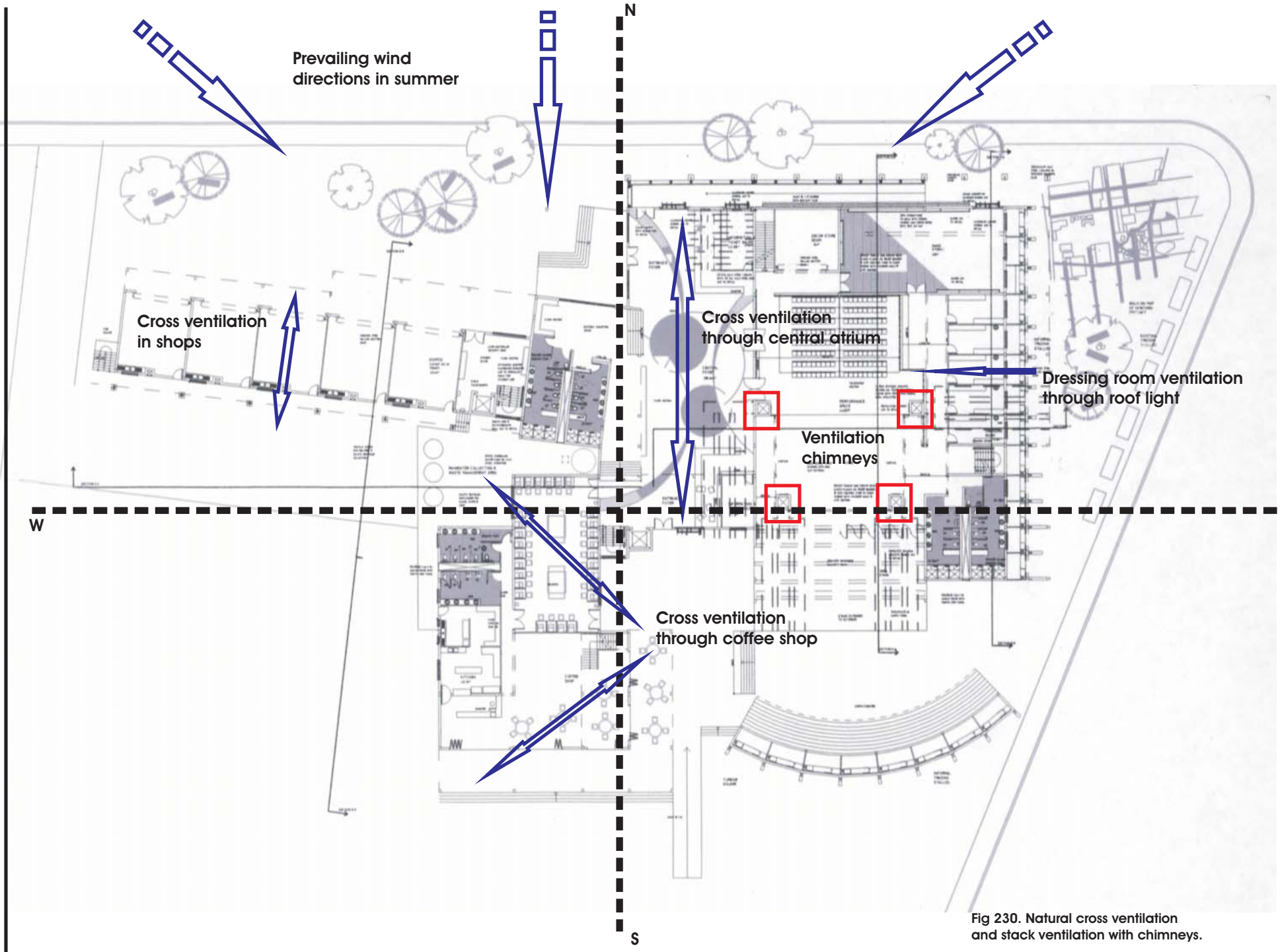


Fig 230. Natural cross ventilation and stack ventilation with chimneys.

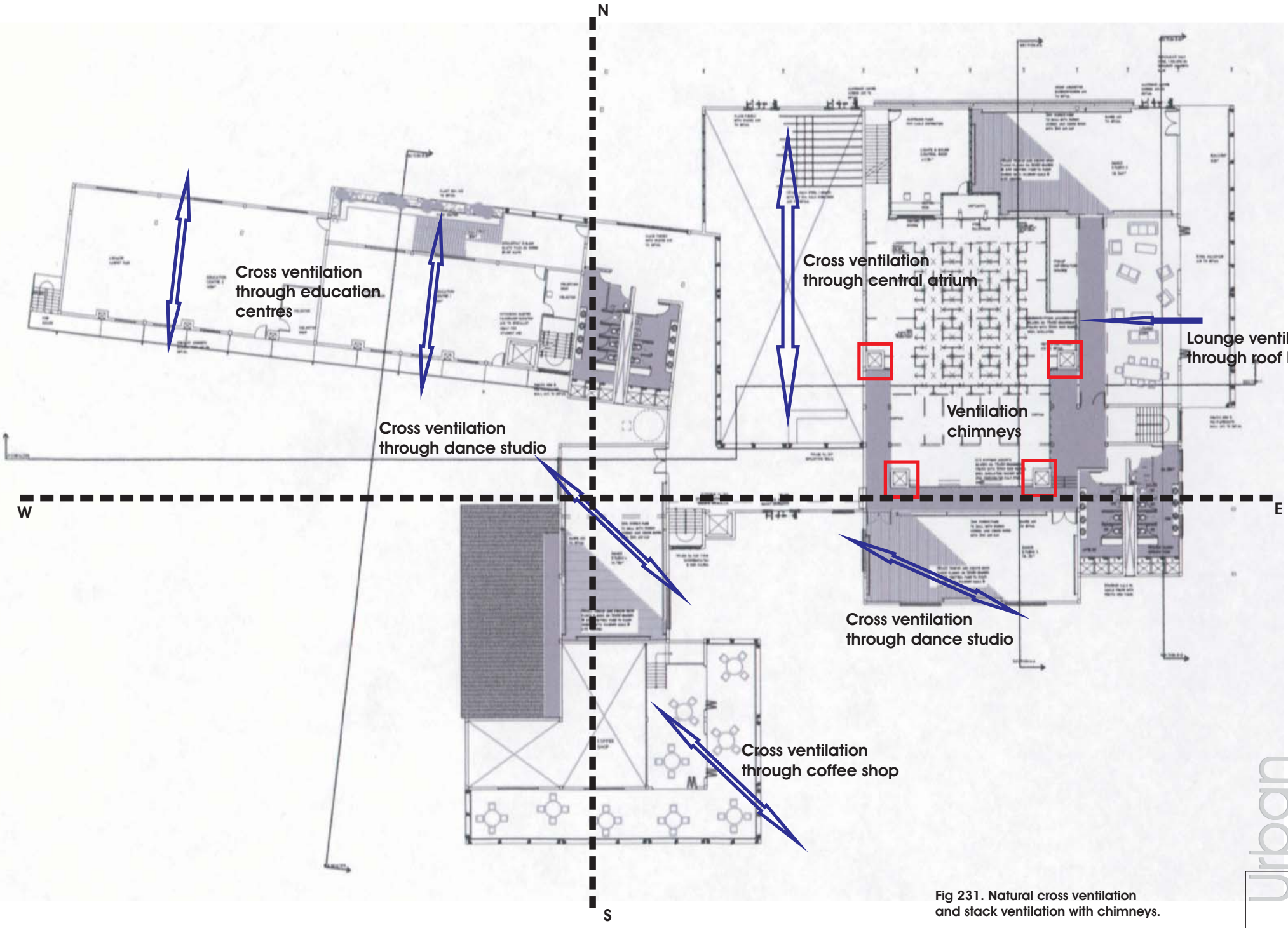


Fig 231. Natural cross ventilation and stack ventilation with chimneys.

The benefits of natural ventilation by means of towers are rediscovered to provide habitable spaces. During the Victorian era, the English became obsessed with clean air and chimneys and towers were not only used as part of ventilation systems, but served as observation points also. After World War II, the advent of central air conditioning and the sealed building, made natural ventilation an anachronism. The use of chimneys for ventilation minimizes rising energy costs. Chimneys and towers are key architectural elements for harnessing pressure differentials by employing the stack effect.

Chimneys are used in a great variety of spaces: from atriums to high-ceiling auditoriums. Chimneys should terminate above the ridge f the roof to prevent being located in a high pressure zone. Hot air may otherwise be pushed back into a space. The top parts of these chimneys are critical in ventilation design. Some towers absorb solar energy and others use tower-top cowlings that rotate in the wind. The four faces of a chimney can be designed to draw in wind regardless of the wind direction. Arup and Max Fordham have developed proprietary computer programmes to help determine tower and chimney parameters (Wilmert, 2000:138). A computer model of the proposed design, with weather data integrated into the program, can simulate the factors determining airflow. Wind-tunnel testing of scale models has proved to be an effective tool to analyze air movement through a building. These vertical gestures can become distinctive elements where architectural design and building service systems are integrated.

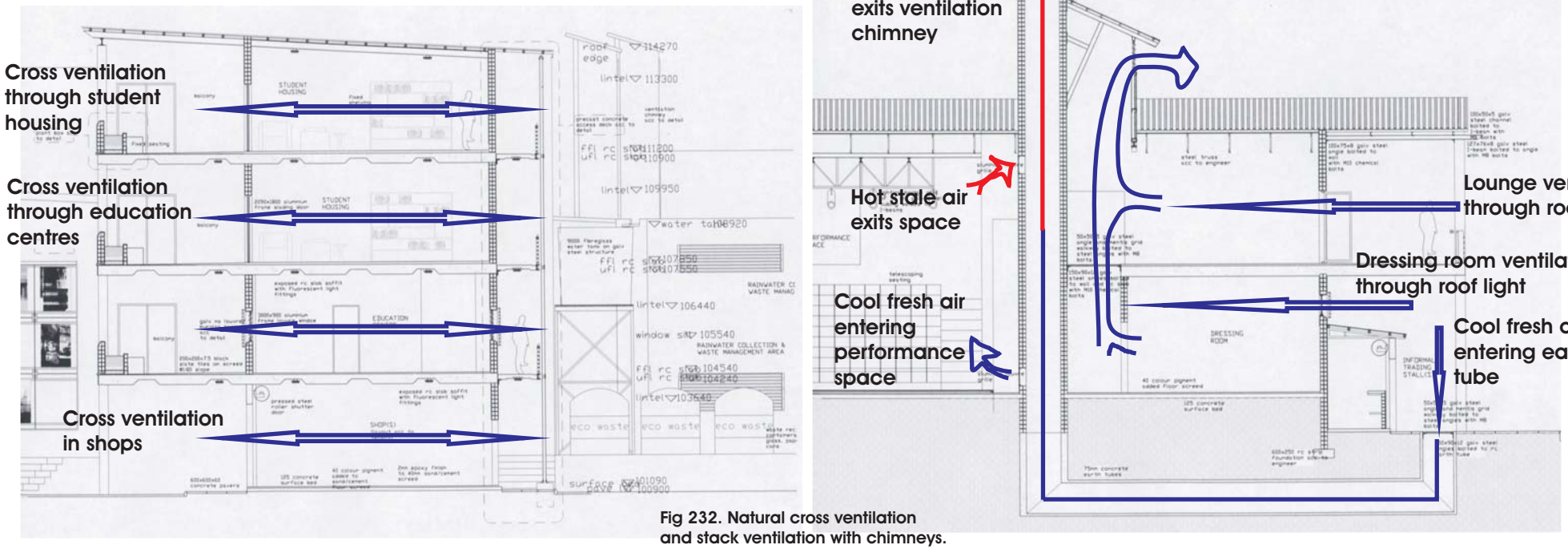


Fig 232. Natural cross ventilation and stack ventilation with chimneys.

The benefits of natural ventilation by means of towers are rediscovered to provide habitable spaces. During the Victorian era, the English became obsessed with clean air and chimneys and towers were not only used as part of ventilation systems, but served as observation points also. After World War II, the advent of central air conditioning and the sealed building, made natural ventilation an anachronism. The use of chimneys for ventilation minimizes rising energy costs. Chimneys and towers are key architectural elements for harnessing pressure differentials by employing the stack effect.

Chimneys are used in a great variety of spaces: from atriums to high-ceiling auditoriums. Chimneys should terminate above the ridge f the roof to prevent being located in a high pressure zone. Hot air may otherwise be pushed back into a space. The top parts of these chimneys are critical in ventilation design. Some towers absorb solar energy and others use tower-top cowlings that rotate in the wind. The four faces of a chimney can be designed to draw in wind regardless of the wind direction. Arup and Max Fordham have developed proprietary computer programmes to help determine tower and chimney parameters (Wilmert, 2000:138). A computer model of the proposed design, with weather data integrated into the program, can simulate the factors determining airflow. Wind-tunnel testing of scale models has proved to be an effective tool to analyze air movement through a building. These vertical gestures can become distinctive elements where architectural design and building service systems are integrated.

Noise:

Sound affects the occupants of a building in two ways:

- Annoyance with loud noise (unwanted sound)
- The quality of sounds generated within the building.

Vibrations from a source of sound set the surrounding air molecules into a similar physical motion. These vibrations can be transmitted through air or other "elastic" medium, including most building construction materials. Sound vibrations impinging upon the ear create similar vibrations of the eardrum. Sound travels at a velocity of 343 m/s in air at sea level, but much faster in solids. The velocity of sound in structural steel is about 5 000 m/s (Bradshaw, 1993: 430). Sound is identified by frequencies ranging from 20 Hz to about 20 000 Hz.

The range of sound pressures important to us is presented on a logarithmic scale, called the decibel scale. A decibel (dB) is the ratio of sound pressure to a base level chosen at the threshold of human hearing. A 3 dB sound pressure level is barely perceptible to the human ear. An increase in 10 dB is perceived as doubling of loudness (Bradshaw, 1993:434).

The accepted noise levels in dB are:

- Small auditoria, conference, lecture rooms: 45 dB 50 dB
- Bedrooms for sleeping and resting: 30 dB 40 dB (Krige, 200:28)

A source of noise, like a road, is considered as a linear source: the sound is generated along a line . For linear sources, the sound level falls off 3 dB with each doubling of the distance from the line source (Brown,1982 :14.3). The linear sources of noise on the site are the elevated M1 freeway which forms the western boundary of Newtown and Jeppe and West streets north and east to the site.

The average noise level next to the M1 = 73.0 dB (Kirchchofer, 1980:6) According to the 3 dB fall standard, the noise level from the M1 at the site will be approximately 48 dB. The site is protected by the bulky structure of the Turbine Hall to the west of the site, creating a barrier between the freeway noise and the site.

The noise level is approximately 75 dB alongside a kerbside of a fairly busy street. A rate of 10 vehicles/minute produces 63 dB (Humphrey, 1978,143). These values relate to the traffic circulation around the site. Jeppe Street acts as a linear source of noise to the northern edge of the site. Traffic will rarely travel faster than 50 km/h, because of the pedestrian orientated environment with integrated road surfaces. The performance space will be located on the public corner along Jeppe Street and additional insulation along the northern façade will be necessary.

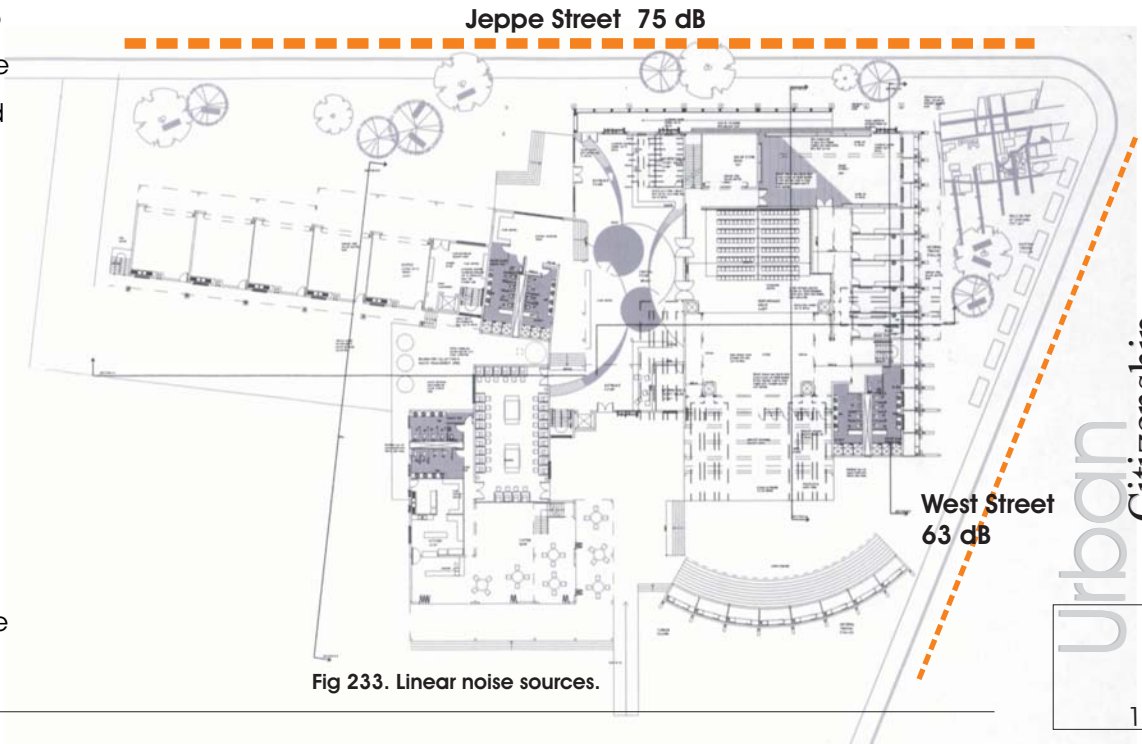


Fig 233. Linear noise sources.

When sound strikes a boundary or surface, part of its energy is absorbed, part is reflected, and part is transmitted through the construction. The sum of all three components is equal to the total incident sound energy. Soft, porous materials, such as wood, fabrics, furnishings and people absorb a large part of the energy striking them.

Sound absorption and sound isolation are two different phenomena. Fiberboard and acoustic tile may reduce the sound energy level within a space, but they do not prevent sound transmission between spaces: they are not good insulators.

The ratio of sound energy absorbed to the sound energy impinging upon a surface is called the absorption coefficient. A sound absorption coefficient of 1 represents total absorption by a material.

Sound transmission from space to space depends on the sound-insulative qualities of the construction between them. The property of the construction materials is known as transmission loss (dB), which represents the difference in sound pressure level between the incident side and the opposite side of the construction. Transmission losses are greater for a more dense, heavy construction. It is more difficult for sound energy to set in motion a heavy partition than a light one. The heavy partition is a better insulator.

Two types of sound absorbers were looked at for the design of the building: dissipative absorbers and panel absorbers. Dissipative absorbers are glass wool, mineral wool, open-cell polyurethane foam and underfelt. These materials have small passages and air-filled cavities that are penetrated by sound energy through the surface of the material. Surface porosity of the material is a requirement to allow sound wave penetration, along with internal porosity. The material must consist of elastic particles or thin fibres, connected to small air passages or cavities for sound to enter and to set these fibres into motion. These materials consist of soft, resilient blankets or panels. Because of finite material thickness, part of the sound energy still pass through the material without being converted into heat. Dissipative absorbers are effective over a wide frequency range and therefore are the most useful and common type of sound absorber with the widest application. These materials are used in acoustic design for the control of reverberation time and noise. They are used in conjunction with insulating materials to construct walls and panels. Semi-open protective covers have no detrimental effect on absorption if the percentage open area is at least 20% (Van Zyl, 2000, 6.2). Acoustically transculant protective covers include:

- Perforated vinyl
- Perforated steel
- Woven cloth
- Shade netting
- Wooden slats with openings
- Expanded metal

The other type of sound absorber is a panel absorber. A sound wave incident on a panel will set it into vibration. A panel over an air gap creates a resonating system with resonance frequency determined by the panel's mass, and air stiffness. If the panel resonates from sound energy, it absorbs energy from the sound wave. Discontinuity in construction is an effective way of improving sound insulation. The wall must be divided into two separate skins. If a wall consists of two layers with an air space between them, both layers must be set into motion in order to transmit sound across the construction. It is very difficult to achieve complete discontinuity: structural connections between solid walls and screens will transmit sound between the surfaces across the space. Typical of such a panel is a plywood panel on a wooden framework or gypsum ceiling boards on brandering.

Description	Frequency [Hz]					
	125	250	500	1 k	2 k	4k
Hard Finishes						
Brick unplastered	0.02	0.03	0.03	0.04	0.05	0.07
Brick plastered	0.01	0.02	0.02	0.02	0.03	0.03
Concrete smooth unpainted	0.01	0.01	0.02	0.02	0.02	0.03
Concrete smooth painted	0.01	0.01	0.01	0.02	0.02	0.02
Plastered wall unpainted	0.03	0.03	0.02	0.03	0.04	0.05
Tiling glazed	0.01	0.01	0.01	0.01	0.02	0.02
Marble	0.01	0.01	0.01	0.01	0.02	0.02
Steel solid	0.01	0.01	0.01	0.01	0.01	0.01
Steel (1 mm plate) over air space with glass wool	0.20	0.20	0.10	0.02	0.01	0.01
Water	0.01	0.01	0.01	0.01	0.15	0.20
Floors & Floor Coverings						
Floor concrete smooth	0.01	0.01	0.01	0.02	0.02	0.02
Floor tiles glazed	0.01	0.01	0.01	0.01	0.02	0.02
20 mm thick plank floor on joists	0.15	0.12	0.11	0.10	0.08	0.08
Wood block floor on concrete	0.02	0.04	0.05	0.05	0.10	0.05
5mm Cork on concrete	0.05	0.02	0.05	0.15	0.08	0.02
Vinyl on concrete	0.02	0.04	0.05	0.05	0.07	0.04
6 mm Carpet tiles on concrete	0.06	0.06	0.05	0.07	0.10	0.17
10 mm Carpet on concrete	0.02	0.08	0.16	0.35	0.55	0.70
6 mm Carpet on 10 mm Under-felt	0.08	0.24	0.57	0.69	0.71	0.73
10 mm Carpet on wooden floor on joists	0.20	0.25	0.30	0.30	0.50	0.60

Room Contents	Unit	Amount of absorption [m^2]					
		125	250	500	1 k	2 k	4 k
Air	Per m^3	0.000	0.001	0.003	0.006	0.011	0.029
Seat hard empty	Per seat	0.01	0.02	0.03	0.03	0.04	0.04
Seat hard occupied	Per seat	0.20	0.25	0.38	0.30	0.35	0.30
Seat leatherette upholstered empty	Per seat	0.03	0.05	0.05	0.10	0.15	0.10
Seat leatherette upholstered occupied	Per seat	0.20	0.32	0.38	0.35	0.38	0.38
Seat open weave upholstered empty	Per seat	0.12	0.25	0.28	0.30	0.35	0.36
Seat open weave upholstered occupied	Per seat	0.23	0.37	0.42	0.46	0.45	0.47
Orchestra player with instrument	Per person	0.35	0.75	1.10	1.30	1.20	1.10

Description	Frequency [Hz]					
	125	250	500	1 k	2 k	4k
Glazing & Curtains						
4 mm Glazing	0.35	0.25	0.18	0.12	0.07	0.04
6 mm Glazing	0.18	0.06	0.04	0.03	0.02	0.02
300 gm/ m^2 Curtain straightened and 100 mm from window	0.03	0.04	0.12	0.15	0.22	0.31
300 gm/ m^2 Curtain 50 % draped and 100 mm from window	0.05	0.20	0.35	0.43	0.50	0.60
Ceilings						
12,7 mm Gypsum on brandering under pitched roof	0.33	0.15	0.08	0.04	0.07	0.09
12,7 mm Gypsum on 38 mm brandering against concrete	0.29	0.10	0.05	0.04	0.07	0.09
Acoustic Tiles and Treatments						
25 mm 40 kg/m^3 Fibretone (perforated vinyl facing) Against concrete	0.08	0.24	0.66	1.12	1.00	0.83
40 mm 40 kg/m^3 Fibretone (perforated vinyl facing) Against concrete	0.20	0.62	1.08	1.19	1.03	1.06
25 mm 40 kg/m^3 Fibretone (perforated vinyl facing) In T-Hangers with 300 mm air space	0.44	0.62	1.00	1.00	1.00	1.00
15 mm_Acoustone In T-hangers with 300 mm air space	0.26	0.20	0.30	0.44	0.55	0.69
6 mm Plywood over 60 mm empty air-space	0.30	0.22	0.15	0.09	0.05	0.02
6 mm Plywood over 60 mm air-space filled with glass wool	0.40	0.25	0.15	0.09	0.05	0.02
Glass wool						
50 mm Aerolite against solid backing	0.36	0.34	0.74	0.87	0.85	0.95
50 mm 24 kg/m^3 Glass wool against solid backing	0.27	0.37	0.89	0.98	0.94	0.97
100 mm 24 kg/m^3 Glass wool against solid backing	0.74	0.40	1.11	1.11	1.06	1.04
50 mm 48 kg/m^3 Glass wool against solid backing	0.23	0.47	1.09	1.05	1.02	1.08
100 mm 48 kg/m^3 Glass wool against solid backing	0.83	0.78	1.20	1.09	1.07	1.15
Mineral wool						
50 mm 60 kg/m^3 Mineral wool against solid backing	0.28	0.60	0.99	1.06	1.02	1.02
100 mm 60 kg/m^3 Mineral wool against solid backing	0.69	1.13	1.08	1.04	1.05	1.02
50 mm 80 kg/m^3 Mineral wool against solid backing	0.24	0.57	0.93	1.00	0.96	0.93
100 mm 80 kg/m^3 Mineral wool against solid backing	0.65	1.13	1.08	1.02	0.99	0.99

Fig 234. Sound absorptive materials.

A sound-absorptive barrier will be needed along Jeppe Street. A double-perforated sheet metal barrier or screen filled with insulative material fixed unto the northern façade of the building, and adjoining the performance space, works as a combination of the above principles. Perforated sheet metal can be used for the front layer and a solid panel for the back layer. Light, rust-free materials will be best. The internal space contains mineral wool or any other noise-absorbing material. This type of barrier is the best suited for the urban context. Close inspection should be made of the urban fabric, materials and cultural context, seeing that such a barrier will be a visual feature along Jeppe Street. The barrier can reflect the proportions of the Turbine Halls broken windows, which are a recognizable trait of the old building. The most effective design will respect the integrity of the materials used. A bold, visually coherent solution can be created by keeping lines simple and strong. The simplicity of form and line may be enlivened by using contrasting materials and colours to accent and punctuate the overall design. Metal surfaces can contrast with off-shutter concrete and bright painted steel supports.

Other factors were considered in the design of the sound screen or barrier:

- In urban areas, where there is often a jumble of built forms and a clutter of urban paraphernalia, such as signage, poles and lighting, with a juxtaposition of often discordant materials, a screen with strength of form and a simple design, may be better suited.
- An angled barrier tends to have a more dynamic and designed appearance and makes more of a visual statement. Most barriers are tilted 3 to 15 degrees (Kotzen and English,1999:76) from the vertical, depending on the materials and supports used and the height of the barrier.
- The structure of the barrier may be used as a functional as well as an aesthetic element. The structure may have an important visual function, which defines the character of the barrier. The structure can be either emphasized or down-played, or concealed within the façade to give a seamless appearance to the barrier.
- Where more than one layer of material is used on a barrier, the visual transition between the two layers are important. The first layer can be more visually penetrable than the second layer.
- Barrier design is generally based on the repetition of panel and structure. This strategy is important in keeping down cost and providing visual continuity. Such a surface can become visually boring. This can be prevented by using layering, periodic focal points along the length of the barrier or the rhythmic patterns such as staggered openings punched into layers.
- Patterns of light and shade create a vibrant surface. Patterns should be bold and an integral part of the overall design of the building. The barrier faces north and will receive direct sunlight at different angles. Light falling unto the barrier can create pleasing effects, which alter according to the strength of the changing light, the weather, the angle of the sun and time of the day. This allows a barrier to become more visually complex and interesting, especially when placed in an urban context where views are most likely to be from close up for longer periods of time, like the people slowly moving up the ramp and becoming aware of surfaces an textures around them. Visual complexity is important in these locations in order to avoid visual sterility.
- The texture of the barrier is defined by the material make-up. People moving up the ramp should become aware of the texture of materials.
- Colour are also determined by material, but can be altered with paint, stains or anodizing. A metallic colour gives a high-tech engineered appearance. A surface that gives the appearance of older, stained metal will show its respect to the urban context, seeing that the design will also reflect the proportions of the Turbine Hall's broken windows. Bright colours imply conscious design and the making of a statement. Colouring posts of a barrier red, states that the barrier has some visual or architectural merit. Off-shutter concrete colours, greys, red brick and earthy colours and metallic sheens fit in well with the urban context of Newtown.

Architectural acoustics is concerned with the behavior of sound in closed spaces, where sound is acted upon by the room boundaries. The acoustical objective for an auditorium space is low background noise so that music can be heard clearly. The performance space is insulated against external noise with 12.5mm gyptone acoustic board backed with 50mm rigid mineral wool insulation material. Absorbent materials can be used on surfaces to control echoes. Gyptone acoustic board control echoes. Absorptive materials should not be used inside auditoriums to lower background noise. Absorbent materials should only be used to control reverberation time and echoes. The surrounding construction must be able to exclude enough unwanted background noise by means of absorbent treatment.

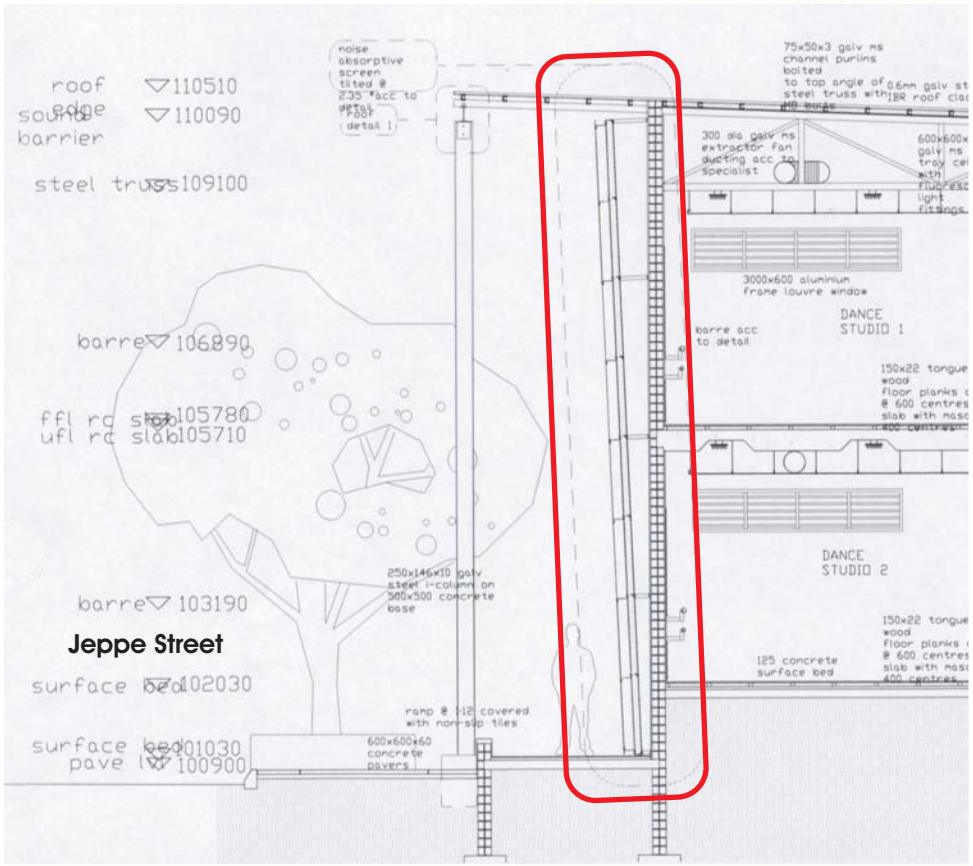


Fig 235. Noise absorptive screen

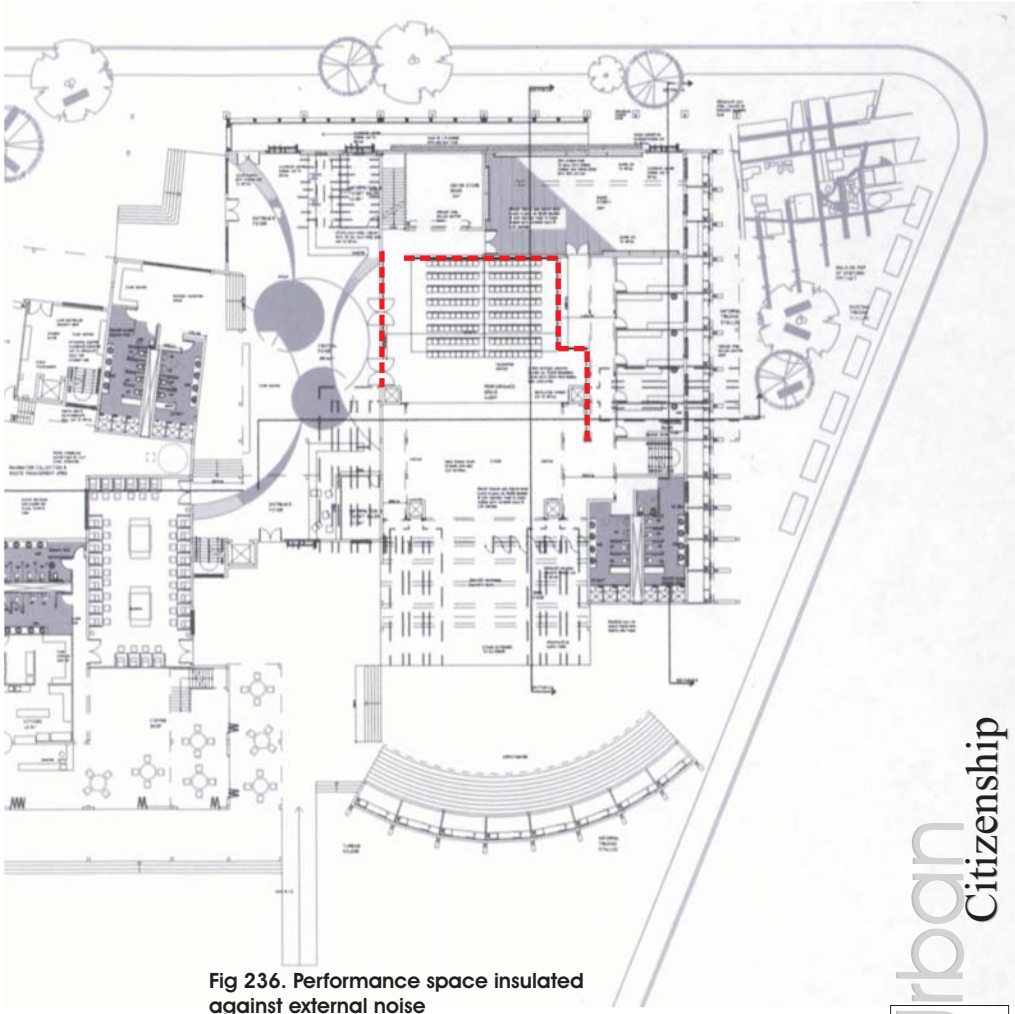


Fig 236. Performance space insulated against external noise

Views:

All living, working and circulation areas have access to a view outside. The student housing units and education center have balconies facing north, looking out onto Jeppe Street. The southern side of these units comprise of an access corridor that look out unto the Turbine Square. The central atrium is highly open to views towards Jeppe Street to the north and to the amphitheatre and Turbine Square towards the south. The northern façade adjoining the performance space is a solid wall that conceals the activities inside the building to the visitor moving up the ramp to the entrance. This creates anticipation to a point of focus where the interior of the atrium space is revealed. The Turbine Square can also be seen right through this space. The southern wall of the building opens up towards the public environment of the Turbine Square. The amphitheatre integrates the public environment into the atrium space of the building. A progressive flow from inside to the outside of the building is created. All users are situated not more than 6 m from a window with a view.

Access to green outside:

The public will have access to green outside spaces that integrates and form part of the public environment. Tree-lined streets like Jeppe and West Streets provide cool comfortable spaces during hot summer months. Shade will also be provided in the amphitheatre during summer where visitors can socialize while enjoying the outside dance performances.

Inclusive environment:

Buildings should be designed to accommodate a wide variety of activities, users and times of usage.

Public transport:

There has to be a focus on public transportation for two main reasons. Firstly, a vast percentage of residents will never be able to afford a private car. Secondly, it is more efficient to move a number of people in one public vehicle than having numerous, usually single occupant, private vehicles clog the roads. The building is located within 100 metres of a disabled accessible public transport system. A bus stop is located in West Street adjoining the Turbine Square. This stop is located within 50 metre of the building. The minibus-taxi routes are as pervasive in the area as the bus services. The minibus routes converge on the CBD as the major interchange center for their services, and many ranking facilities, such as the Metro Mall, are within one city block of the site.

Fig 237. View out unto Jeppe Street from balconies

Fig 238. Amphitheatre space as transitional link between interior of building and public square.

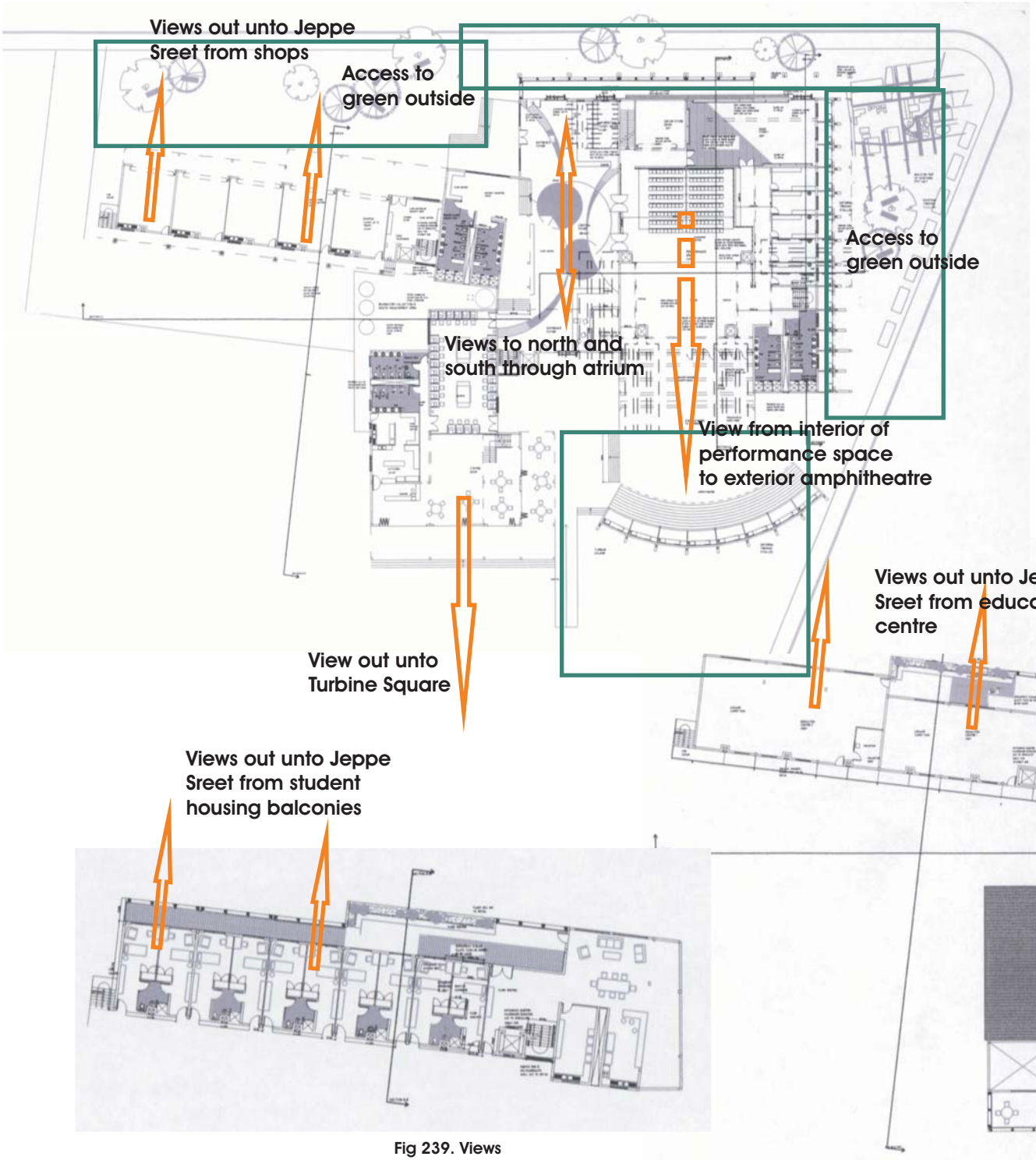


Fig 239. Views

Fig 240. View out unto Turbine Square from coffee shop

Routes:

All routes between and within buildings are of a smooth and even surface. All routes and entrances are accessible for wheelchairs. Regulations require a minimum of 1/100th of the audience capacity for wheelchair users in a performance space. Their location can be in front, at the sides of the retractable seating. A wheelchair user should be able to sit with a party of friends not in wheelchairs. Sight lines from the wheelchair should be checked, as should the sight lines of the audience members behind. Wheelchair users can also transfer into retractable seating and the wheelchair put on the side. Enough space must be provided for this. Dance performances should not only be undertaken by the young, fit and able-bodied: disabled and elderly people will also take part in programmes and performances. Therefore all surfaces should be accessible for wheelchairs. Lifts and ramps will provide access to the upper floors.

Changes in level:

All areas will be accessible for the disabled. All changes in levels will be catered for with appropriate ramps of a fall not more than 1:12. Two lifts will be provided.

Edges:

All edges between walls and floors and stair nosings must be clearly distinguished through the use of contrasting colour for the visually impaired.

Toilets:

The required number of disabled toilets will be provided. One disabled toilet will be provided on the ground floor and the first floor.

Access to facilities:

Convention living and working patterns requires regular access to a range of services. Ensuring that these services can be accessed easily and in environmentally friendly ways supports sustainability by increasing efficiency and reducing environmental impact. The whole Newtown development vision is based on creating an active and vibrant public environment, within a milieu of art and cultural activities, with supporting retail, commercial, business, office and residential uses. Pedestrians are accommodated as the major form of movement in an easy, safe, convenient and pleasant environment. Vehicular movement will be coordinated and access to well located and safe parking areas will be available. The proposal is focussed on a mixed-use development, encouraging the complex integration of cultural, art, entertainment, retail, commercial, office and residential activities. To maintain a sense of continuity and a vibrant urban life, ground floors will accommodate retailing and entertainment: uses that can flow out unto the sidewalk space adjacent to the building. The area around the site is so diverse in facilities that an independent urban environment can be created.

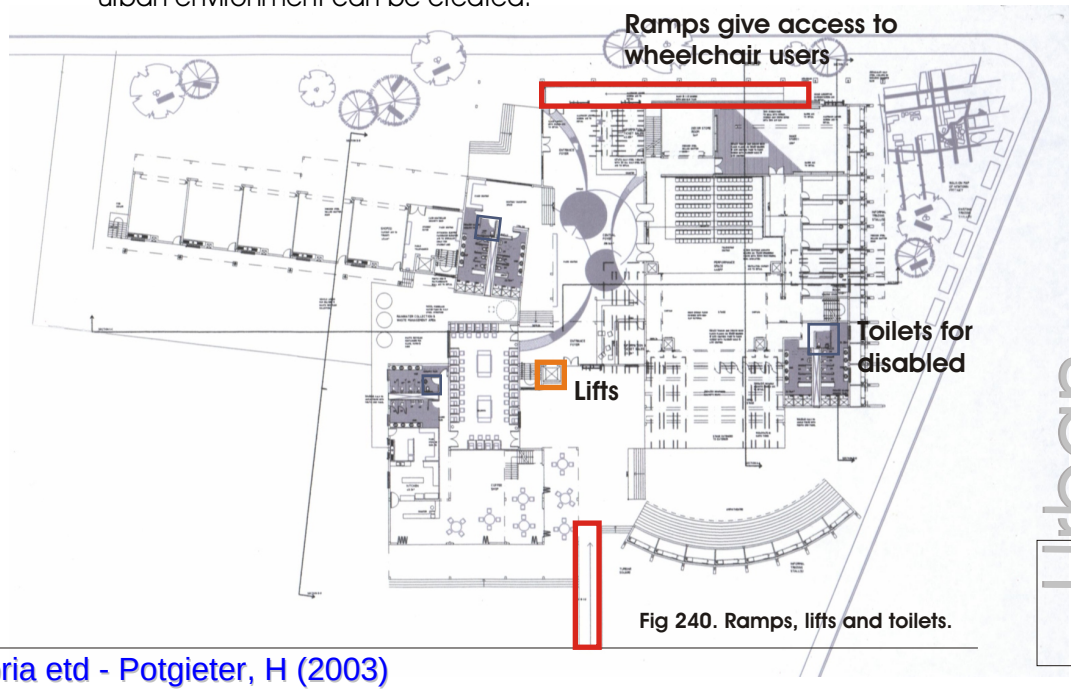


Fig 240. Ramps, lifts and toilets.

Banking:

Banking services (i.e. ATM) are available within 3 km of the building.

Retail:

Small, multi-functional, adaptable shops will be provided along Jeppe Street. Groceries and items required on a day-to-day basis will be available in these retail spaces. Stalls provide opportunities for informal trading. A wide variety of retail is available in the surrounding area.

Communication:

Telephone and Internet facilities for the public will be provided next to the library.

Residential:

A new housing development is in progress that will provide 2200 housing units in Newtown. This residential development is situated north to the site approximately two city blocks away. The development will be targeted to mixed income markets, thereby encouraging diversity and sustainability. Some 1050 of the total number of housing units are to be subsidised, while the remainder will be developed to target earners within the middle-income bracket. Residential densities have to be provided on a differential basis. Higher densities are vital for the provision of public transport and should be concentrated along major routes and around nodes. High densities imply that the single house on a single plot is a notion that has to be reconsidered (also there is not sufficient land for this to be viable). A variety of residential unit types are required, as are various tenure options. Rental stock, in particular, is needed in the city. Student housing will be provided in the building with shared bathroom and self-catering facilities.

Participation and control:

Ensuring that users participate in decisions about their environment helps ensure that they care for and manage this properly. Control over aspects of their local environment enables personal satisfaction and comfort. Both of these support sustainability by promoting proper management of buildings and increasing productivity. The local community must be encouraged to take responsibility for their own actions and be consulted in preparing strategies to manage their environments. In addition, citizens must be continually made aware of and reminded of the aims and objectives of such strategies. Only once you have buy in and support from the community can the implementation of the strategy hope to be successful. The public must be involved in the entire process.

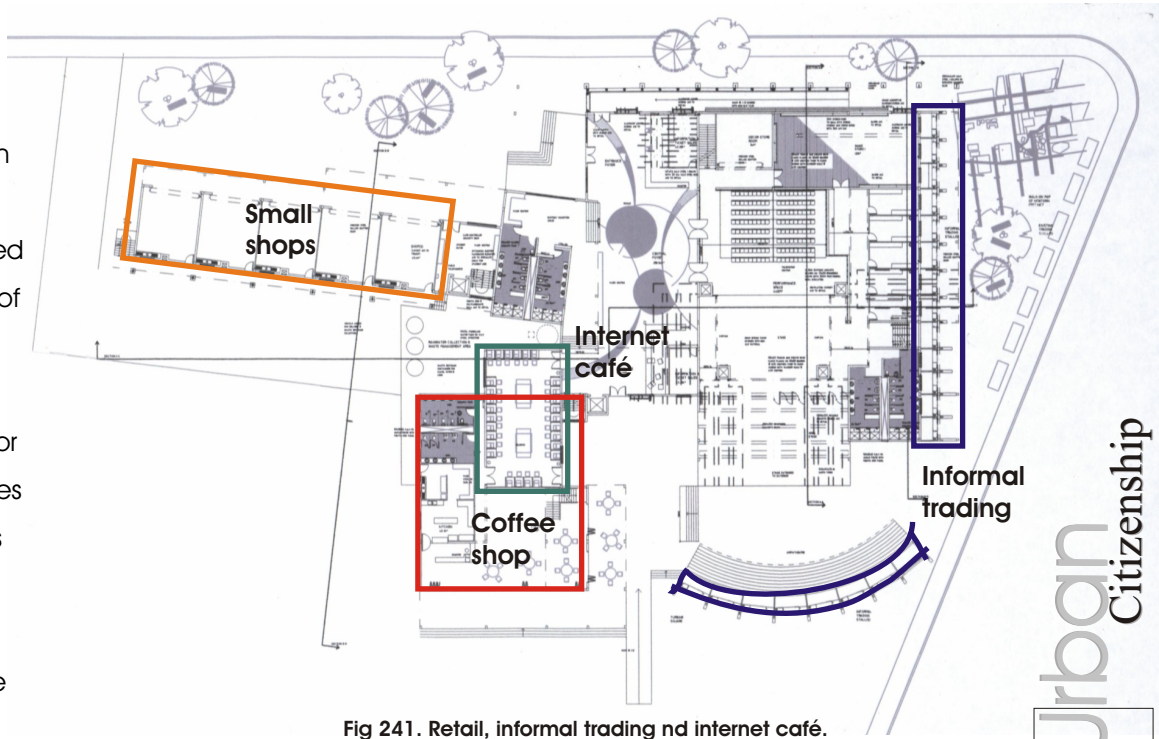


Fig 241. Retail, informal trading nd internet café.

Environmental control:

The users of the building should have reasonable control over their environmental conditions. This includes opening windows and louvers to adjust the internal climate of the building to reach a comfort level.

User adaptation:

Furniture and fittings should be designed to fit a range of functions and users. Tables, chairs, internal partitions should be specified to allow for arrangement or rearrangement by the user. Provision must be made for personalisation of spaces if desired. In a multi-purpose performance space where different formats or uses are combined or where part of the raked seating will removed, bleacher or retractable seating will be used. These are well-developed and highly flexible seating systems offering great variety. This telescopic structure with tippable upholstered seating with backs is able to retract into the depth of a single and highest row. The space can be cleared for other uses at different times. These systems need a dedicated space into which the seating can be concertina-ed when not in use. Movable acoustic panels separating the interior stage to the exterior stage can be opened or closed according to the use of the space.

Social spaces:

Spaces for informal socialization must be provided for the public. The amphitheatre serves as an informal outdoor space where people can come and go as they please while watching students practising on the stage. This space will function as a sort of an outdoor living room for the public. The amphitheatre is placed along the regularly used route of West Street and is open for access from the Turbine Square. This space acts as the transition space between the interior of the building and the public square. The space is large enough to allow for comfortable social interaction. The building edge that contains the retail, training centre and student housing are set back from the edge of the road to create a space for interaction that flows into the shops. Trees alongside the pavement make this a cool place to use during summer and a warm place during winter. The communal student housing features joint self-catering facilities, laundromat and lounge. These facilities are shared while each student enjoy the privacy of her/his room. The shared facilities encourage social interaction and group activities.

Community involvement:

Spaces or services are shared or made available to local community. This includes access to Internet services, teaching and learning spaces like the education centre and communal student housing.

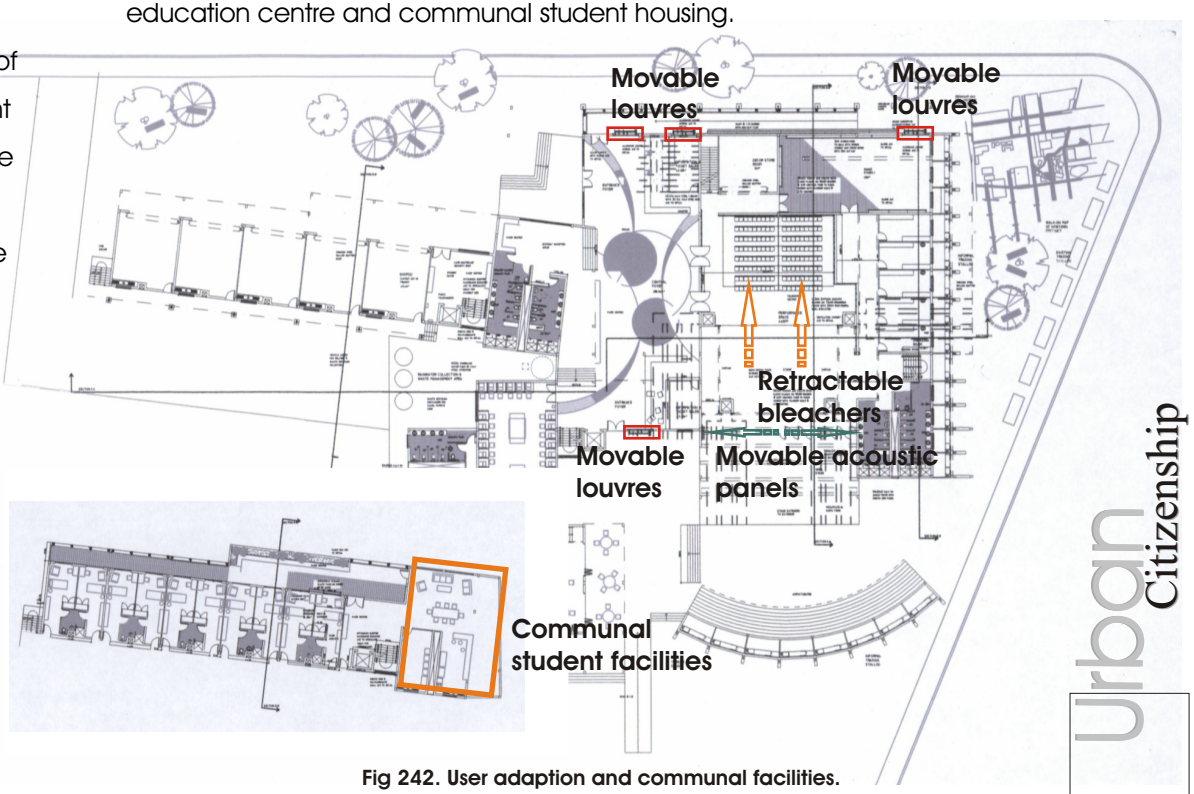


Fig 242. User adaption and communal facilities.

Education, health and safety:

Buildings need to cater for the well being, development and safety of the users of the building. Awareness, and environments that promote health can help reduce the incidence of diseases such as aids. Safe environments and first aid can help limit the incidence of accidents and where these occur, reduce the effect. Learning and access to information is increasingly seen as a requirement of a competitive work force. All of these factors contribute to sustainability by helping ensure that people remain healthy and economically active, thus reducing the 'costs' (to society, the environment and the economy) of unemployment and ill health.

We must be commitment to making Johannesburg "An African World Class City" by concentrating its efforts on the stimulation of economic growth and job creation, preventing crime, building and reinforcing practices of good governance, ensure customer care and service delivery, addressing the HIV/Aids epidemic and regenerating the inner city of Johannesburg.

Johannesburg is home to a population of 2 883 226 people in some 791 367 households. The population is projected to rise to 2 986 228 in mid 2005 and 3 103 182 in mid 2010. The average rate of growth between 2000 and 2010 is projected to be 0.9% per annum. The African share of the population is projected to rise from 72% in 2000 to 74.7% in 2010, the Coloured share to remain constant at 6.5%, the Asian share to rise from 3.7% to 4%, and the White share to drop from 17.4% to 14.8%.

In 2002, the City of Johannesburg developed a long-term strategy with a 30-year horizon, known as "Joburg 2030" Integrated Development Plan (IDP). This is an overarching vision, policy and strategy that will guide all council's strategic decisions, resource allocation and operational management activities. The key object of the strategy is to achieve a better quality of life for the city's citizens by increasing the standard and quality of life, measured by income per capita, and the Human Development Index (HDI). (Masondo, 2002).

Health:

The HIV/Aids epidemic is projected to have a significant impact on demographic trends in the city, as indicated in the low rate of growth above. Other reasons for the low population growth include low fertility in Johannesburg and modest in-migration. Aids will wreak its heaviest impact on black residents, with the most dramatic impact on African women. The decline in mortality, prevalence and all other relevant indicators between 2000 and 2010 suggest the epidemic has peaked. The average annual number of HIV positive births is around 2 889 in 2000, however, at least 50% of these infections could be preventable. There is a significant difference between male and female prevalence, which is consistent through time. In 2000, female versus male infection levels were 157 861 and 128 667 respectively. The total number of Aids orphans will increase from 76 623 in 2000 to a cumulative total of 139 419 in 2010. Government at all levels needs to cater for this growing social problem (Masondo, 2002: 4.2).

Our newly formed democracy, have led to a shift from traditional approaches to primary health care service delivery. The IDP suggests the new approach, which is based on primary health care delivery through the district health system. It has a strong focus on promotive and preventative health service delivery that is both accessible and effective. Gauteng showed the largest increase in HIV/Aids prevalence in 2000. The City of Johannesburg is taking up the challenges of providing primary health care services and dealing with HIV/Aids through

targeted strategies and a range of initiatives that will be implemented through its Health Department (Johannesburg City Council, 2001:57). Medical advances and higher standards of living will ensure that HIV/Aids will no longer be a run away pandemic in the city, though the legacy of Aids orphans and other social implications will still be felt. The social services sector will be sufficiently resourced to manage these issues. Infant mortality rates will have decreased and life expectancy will have increased. The population will be beginning to age as the birth rate falls. Private sector health demand will increase and public health facilities will be able to focus on smaller lower income communities.

Education:

All citizens have the right to be literate and numerate. School attendance, in line with legislation, must be strictly enforced and truancy will be monitored and punished. Currently in Johannesburg it is estimated that 10% of young children are in early childhood development programmes (Masondo, 2002: 4.8). This average however, varies across the city, with, not unexpectedly, poorer parts of the city having the lowest rates of participation. In relation to skills development, it is proposed that a City Skills Project be developed to create a culture of appropriate learning and to ensure supportive infrastructure utilisation. The City Skills Project will seek to harness all actual and potential educational resources in the city - from crèches to community centres and libraries - in order to develop a culture of learning and technology in the city. By doing so, it will work towards building a strong foundation for the skills the economy requires. This will include, amongst other programmes citizenry and compliance education programmes, holiday and intern programmes for learners and job search facilities. City facilities such as museums, libraries and community centres will be refocused as crucial tools in developing a skilled and educated population. The City Skills Project will also strategically interface with national and provincial education authorities to assist in the transformation of the labour force and learners within the educational system (Johannesburg City Council, 2001: 35)

Internet facilities for the public will be provided in the Internet café. Lack of access to information has a debilitating effect on the development and empowerment of poor and disadvantaged groups who are isolated from opportunities. Access to information and technology immediately opens up opportunities for self-improvement. The education centres will provide the space for education programmes for the young to the old.

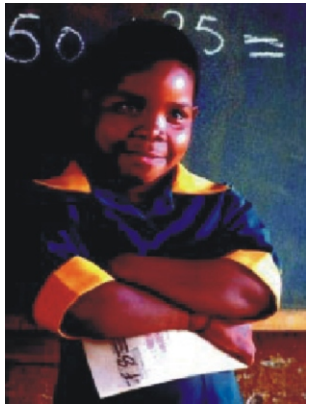


Fig 244. Education programmes for a sustainable future.

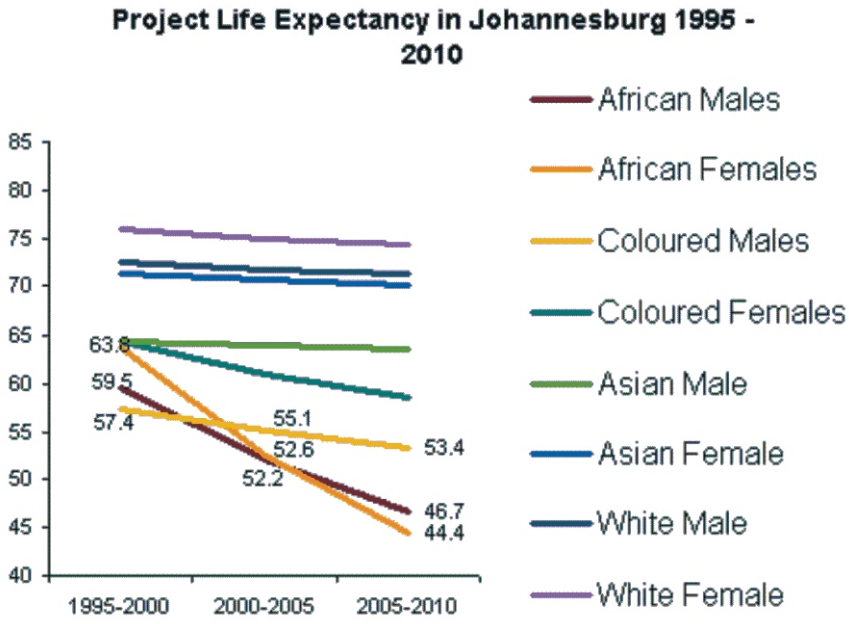


Fig 245. Life expectancy of citizens of Johannesburg: 1995 - 2010.

Safety of the public environment:

Crime is an input, which does not exist for the majority of countries, but in South Africa, and specifically in Johannesburg, it was found to have a major impact not only on efficiency and profitability, but that it was the major constraint regarding new investment decision making. An econometric model was developed which showed that investment had a crime elasticity of 0.61 (Masondo, 2002: 4.6). This means that 61 percent of any decision to invest in Johannesburg will be determined by the deciding bodies view of crime in the city.

Following the national trend of a 15% increase in crime between 1994 and 1999, Johannesburg's crime rate has also increased. In many respects, crime in Johannesburg is of particular concern because it is the economic centre of the country. More than 50% of the total vehicle thefts in South African occur in Johannesburg, with a significant percentage of organised crime, fraud and computer crime concentrated in the city. Patterns of violent crime and rape show that a high proportion of these crimes are also concentrated in Gauteng. During 1999, one in every four residents in Gauteng had experienced at least one crime. This actual experience of crime has led to decreased levels of confidence among people in the ability of the police to assure their safety. The crime-pattern analysis makes clear that economic crimes are concentrated in the northern and central parts of the city, whereas violent and sex crimes are most prevalent in those areas where there are large concentrations of high-density, poor households - generally the township areas of the city.The National Victim Survey found that 54% of assaults and 68% of sexual offences occur in and around the home of the victim, with 34% and 28% respectively involve a perpetrator who is known to the victim. It is significant that it is young men who are the key offenders of violent crime, and it is other young people and women who are the primary victims of these crimes. Based on the available data, experts in the field agree that between 70% and 80% of all crime is committed by between 5% and 10% of the young male population. Nearly 40% of the victims of violent crime are young men and women between the ages of 25 and 34 with the balance being mainly women in the home (Masondo, 2002: 4.6).

There are two key priorities necessary to create a conducive environment for growth in Johannesburg: they are crime and skills education. Of these, crime is by far the most serious problem, hence reducing crime and its impact on investment decision-making, becomes the crucial intervention necessary to re-establish conditions for growth in the city. A number of strategic proposals are put forward in respect of crime. First and foremost, it is recommended in the IDP that the safety and security initiative re-orientate itself around an outcome that is expressed more in economic than in purely social terms. That is, the city should aim to improve safety and security so that business confidence and business investment decision making is no longer negatively influenced by crime. The resultant reversals in investment and business confidence will lead to improved employment and standards of living. This will reduce one of the key social and economic factors that fuel crime. Another part of the strategy is to ensure that enforcement that is within the council's legislated powers is taken up and zealously enforced. The city's Metro Police Department will gear up to launch a zero-tolerance campaign. The Metropolitan Police Department and Emergency Management Services carry a key responsibility in giving effect to the city's safety and security strategy. The council has taken the initiative against crime by creating its own city police force, and mounting video surveillance cameras in strategic spots to keep a watch on the streets. Some R258-million has been allocated to the fight against crime, and hundreds of new metro police officers will be employed or trained over the next three years. The initial focus is on the city's worst crime spots, like Newtown and the CBD.

Measures taken to ensure that areas of the buildings and routes to and from the building are safe, and feel safe. Measures taken include well lit routes, routes and spaces overlooked by occupied areas and clear visual links between spaces.

Safety of the building:

Measures taken to ensure that areas of the buildings and routes to and from the building are safe, and feel safe. Measures taken include well-lit routes, routes and spaces overlooked by occupied areas and clear visual links between spaces. Only students have access to a small foyer by means of a security card. A lift and stair takes them from here directly to the student housing on the second and third floors. The public using the rest of the facilities in the building do not have access at all to the student housing.

All aluminium sliding windows will be fixed with steel louvers to keep out criminals. The informal trading stalls and small retail shops will be protected by Wispeco steel roller doors. These doors are extremely secure and can be operated with a minimum of effort. Security is another major consideration that has gone into the design and manufacture of these doors. The doors are made of a continuous curtain of pressed steel. The door has exclusive tamperproof slide bolt locking. This heavy-duty system is located on one side at waist height to provide improved "no bending" convenience. Other lock options are available to suit your specific needs. These include a waist high external pad bolt, a Centre Lift Lock with external key and internal turn knob operation, and floor level 4-point slide bolts. The aluminium bottom rail with optional weather-strip gives added protection against dirt, leaves and weather. The Southern wall opening up towards the amphitheatre will be protected with a roller grille when the space is closed.

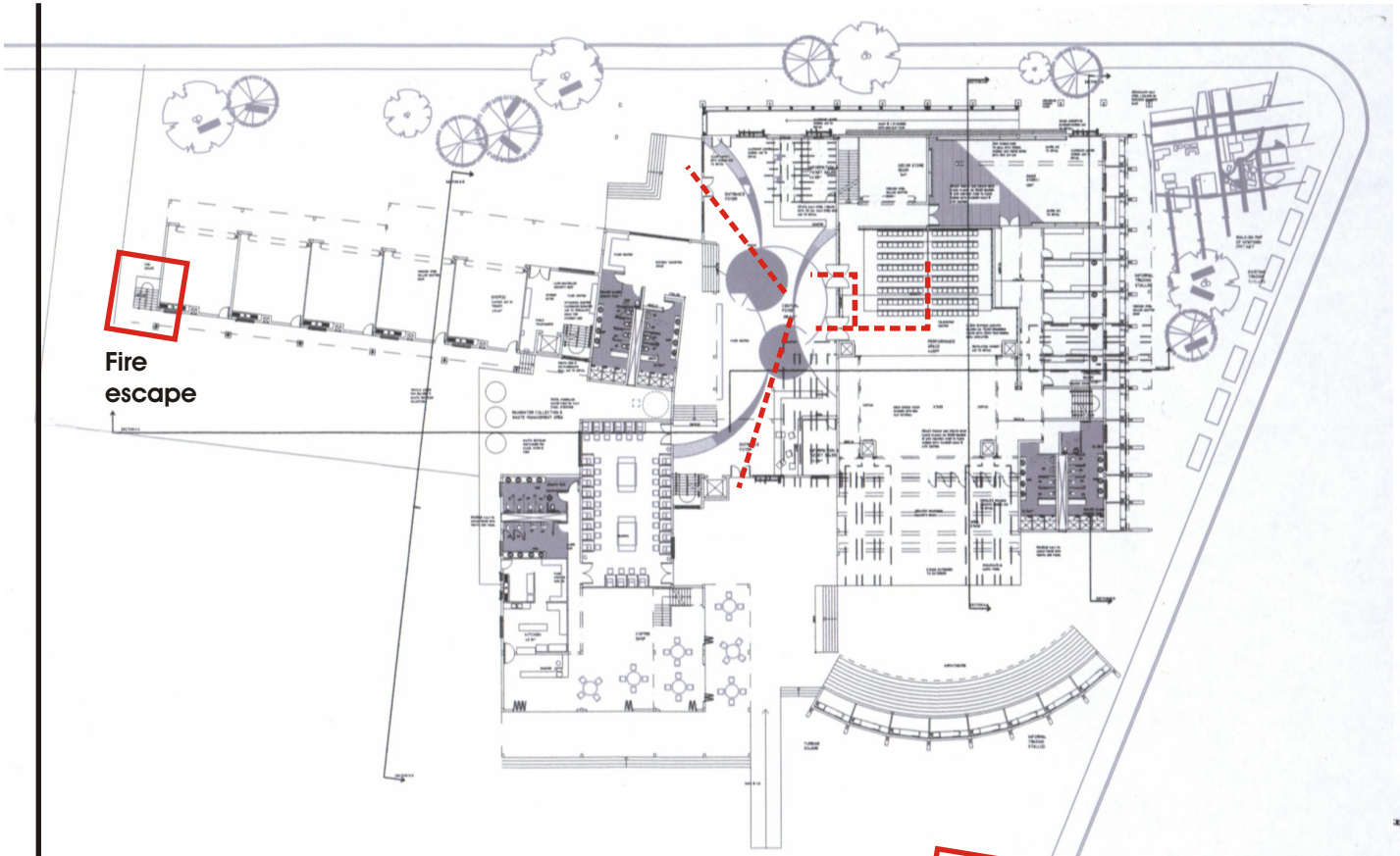
Fire protection:

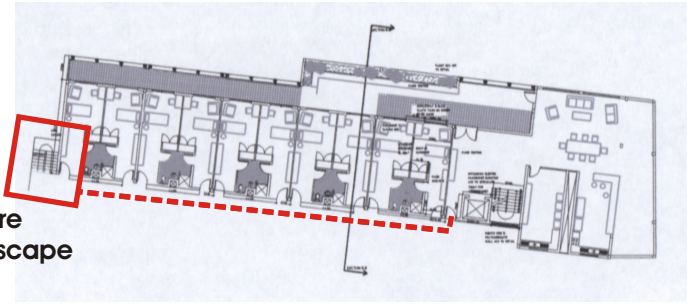
No travel distance to an escape door exceeds 45m. SABS standards qualify all spaces within the center as A2/ F2 en H3 (theatre, small shops and residential). The maximum width of an escape route for 80 people using the 2 education centers is 1200m. All emergency routes are provided with artificial lighting with a minimum illuminance of 50 lux on a horizontal plane 100mm above the floor. The public section of the building will be equipped with a fire detection system and an emergency evacuation communication system complying with SABS 0139. Hose reels for the purpose of fire fighting shall be installed in the building at a rate of 1 hose reel per storey or at least one for every 500 sqr m of floor area of such storey. Any hose reel installed in the building shall comply with the requirements contained in SABS 543. 3.9 l portable water type fire extinguishers are provided at a rate of 1 per 200 sqr m of floor area.

No materials that are combustible are used in the performance space. No seat in the performance space is more than 21 m from an escape door. The exit routes shoulds be related to the normal circulation of the public. Exits should be away from the stage. (Corry,1980:49) Exit widths should be such as to permit an audience to leave the performance space in two and a half minutes.
The exit doors are provided with approved panic bolts and are never locked when the space is occupied.

Smoking:

Spaces will be provided for smokers. Smoking will otherwise occur on balconies or outside the building.





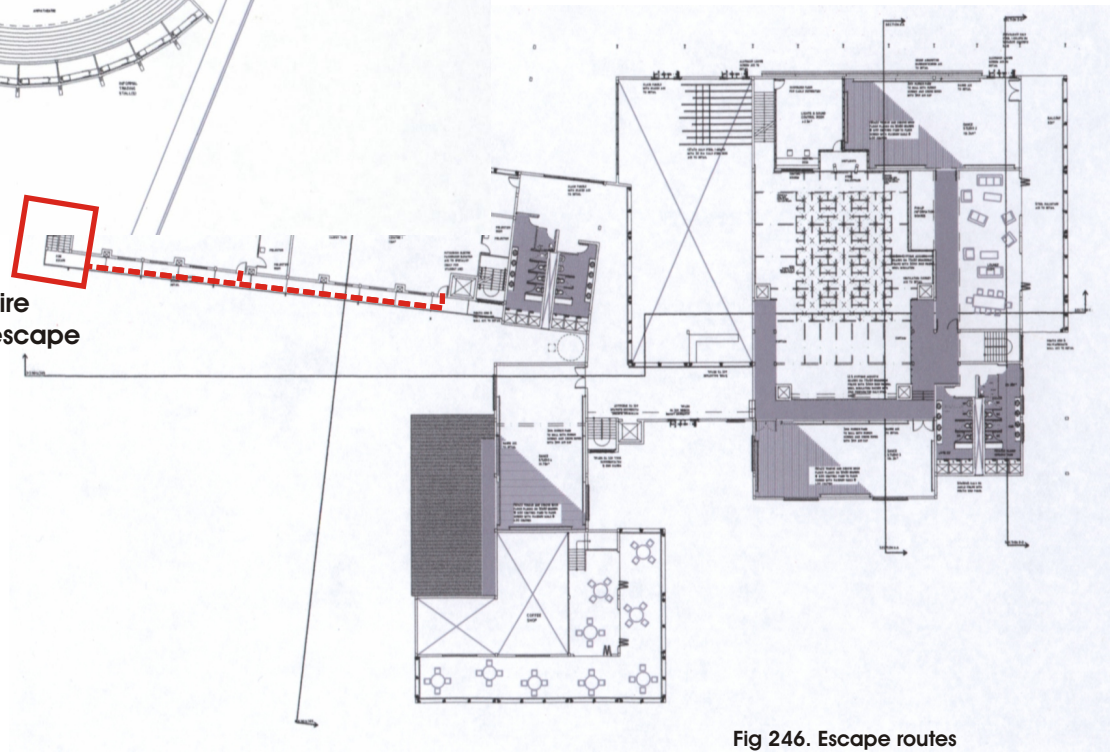


Fig 246. Escape routes

Environmental issues:

Energy:

Energy efficiency must be an important consideration in the design of a building. During the design process, careful consideration must be given to the selection of building and system components with regard to energy efficiency. Renewable resources are available indefinitely but at a finite rate of replenishment. Solar energy, as a renewable resource, supplies the earth with energy at a relatively steady rate, and will continue to do so for the future. The fact is that the worldwide supply of non-renewable resources is dwindling, and energy costs will rise over the long term. Two things are certain: there is a fixed limit to non-renewable fuel resources, and we are using them up at a rapid rate. The result is that a building which is designed today with a 50-year functional life and a 100-year structural life may very well outlast the supply of fossil fuels.

Designers are faced with the following challenges:

- The minimum use of energy that can be justified within a current economic condition.
- Design buildings so that they can be eventually weaned away from dependence upon non-renewable resources.

The concept of the building envelope is evolving into that of an "energy mediator": sensitively attuned to the indigenous natural resources of the sun, wind and water. These are viewed as resources to be manipulated to balance the energy flows across this envelope, rather than as environmental intruders. By displacing mechanical and electrical systems with passive environmental control systems in the envelope itself, energy consumption can be minimized. Up to 20% of energy use can be saved by establishing a building culture of cooler clothes, cross ventilation, stack ventilation and direct heat gain (Gibbert, 2002).

There are five main design factors that influence the energy consumption in a building:

- Function of building.
- Climate.
- Occupancy.
- Building design.
- Building services.

The energy requirements for the centre are approximately the same as the requirements for a school or a university facility. The energy consumption due to energy losses and gains through the facade can be reduced dramatically by selecting a proper shape for the building. There is an increase in energy consumption when the number of storeys increases:

FUNCTION	ENERGY CONSUMPTION RANGE
Offices > 2 000m²	250 - 410 KWh/m².annum
Offices < 2 000m²	220 - 310 KWh/m².annum
Hotels	290 - 420 KWh/m².annum
Cinemas	650 - 780 KWh/m².annum
Schools	180 - 240 KWh/m².annum
Supermarket	1 070 - 1 350 KWh/m².annum
Universities	325 - 355 KWh/m².annum
Mini Factories	190 - 270 KWh/m².annum

Fig 247. Function and energy consumption of a building.

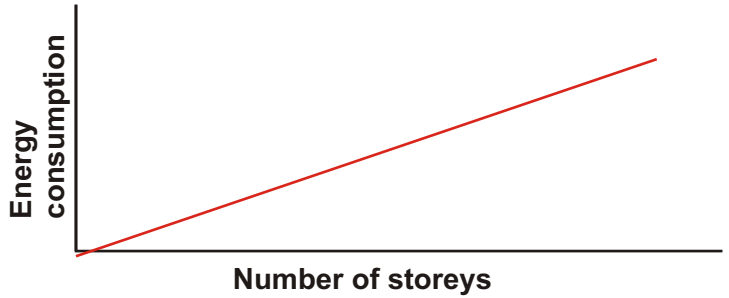


Fig 248. Relationship between energy consumption and number of storeys.

By energy efficient design the architect has the capability to reduce the current loads imposed on the services by 50%

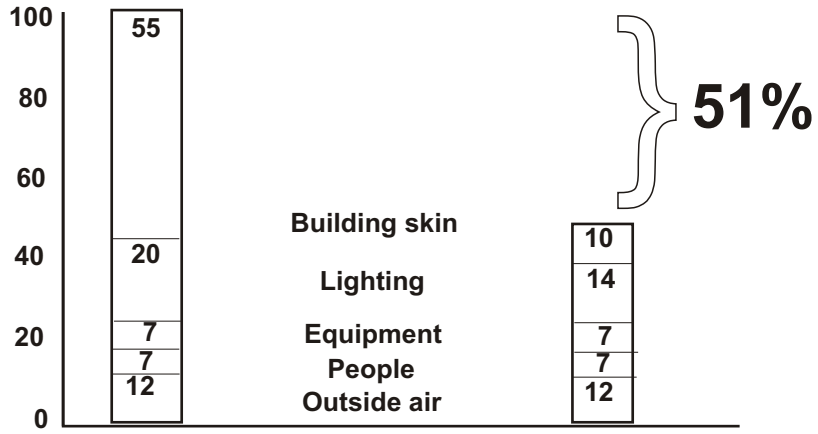


Fig 249. Design lowers the energy costs.

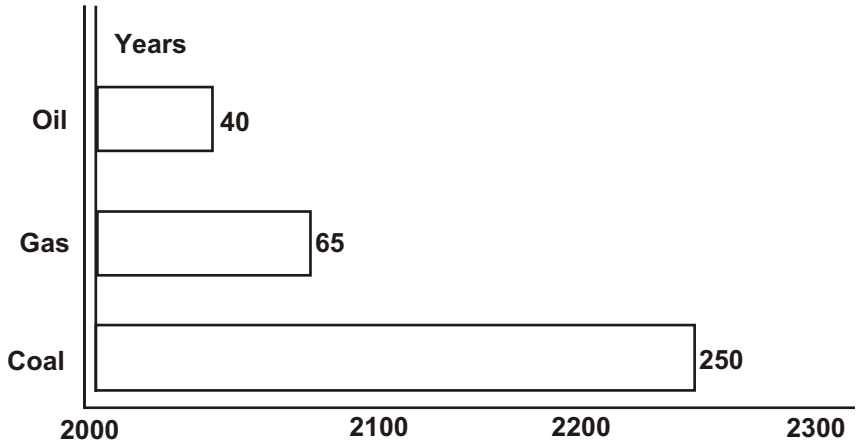


Fig 250. We are running out of energy resources.

Energy contracting is quite new in South Africa. The owner of the building appoints a specialist company to manage the energy and share the savings with the company. The Public Works Department has initiated this type of contract in South Africa and made substantial energy cost savings this way without taking a risk.

An energy code is long overdue in South Africa. The majority of buildings constructed are thermally inefficient which results in substantial high quality energy wastage. The long term cost effect of wasted energy due to these inefficiencies is currently borne by tenants and in the long time by future generations. Making energy conservation part of the design process can only benefit all.

What is not realised by designers is that we are in for an energy shock in the future. The world is slowly running out of energy resources on which we depend. At the moment energy cost is small compared to rental cost which results in complacency in our industry.

Fig 251. We all have a responsibility to save energy.

Heating and cooling systems:

Passive systems work with nature, instead of against it. Generally they are low technology, are lower in cost, and should be designed to be aesthetically appropriate. A building may be thought of as a "footprint" on the land. The ratio of length to width is called the aspect ratio. The height is usually expressed in terms of the number of stories for a given floor area requirement. The optimum shape for a skin-load-dominated building in any climate is a rectangular form elongated some degree in the east-west direction. The longer northern façade of the structure provides a maximum of solar gain during winter, when the bulk of the sunshine is low in the northern sky at an angle of 40 with the horizontal line. The smaller eastern and western exposures minimize heat gain from the longer, low easterly and westerly sweeps of the sun in summer.

Heat transfer between the interior and the exterior is dependant on the surface area of the materials separating the inside from the outside. An elongated form exposes more surface area than a compact form. A thinner, more linear plan takes advantage of natural airflow.

The various modes of operation of a building envelope are:

- admit heat gain
- exclude heat gain
- contain internal heat
- dissipate excess internal heat

The effect of insulation is to reduce heat gain and heat loss. The more insulation in a building's exterior envelope, the less heat transferred into or out of the building. A good insulation material has a low overall conductance to reduce the energy flow across to another material. The insulation retards the flow of heat and therefore has a high resistance. The R-value of a material represents the degree of resistance to heat flow or insulating ability. The U-value is the thermal conductance. The U-value of a roof should be low (well insulated). Thermal conductance, U, is the inverse of thermal resistance, R.

$$U = 1/R$$

One must consider the environmental effects of an insulation material. Foam plastics are petroleum-based, and some utilize CFC's or HCFC's in the manufacturing process. Manufacturers are making considerable progress in producing greener products by substitution of less environmentally damaging CFC's in place of those traditionally used. Some CFC-free materials are available but are not appropriate for all applications. Man-made mineral fibres are generally considered to be "green" material in use, although problems can be created during installation with inhalation of airborne fibres. Foamed glass offers interesting possibilities as a green insulant. Cork can be specified wherever appropriate. Air-gaps and gas-filled voids can also be considered where appropriate.

Insulation products are not easily recyclable but are normally specified for long life. It is generally accepted that the advantage of good insulation (lower energy usage) outweighs the detrimental effects that some materials produce. It is nevertheless important to minimize those effects as far as possible, principally by selecting CFC-free materials where possible. Using waste for insulation materials is already taking place: cellulose-based products, shredded paper and recycled paper and wood, treated to make it fire-resistant, are available. Shredded telephone directories produce a product 25% cheaper than traditional materials (J T Designers, 1993:38).

Sol-Thermo Loft International is a new company based in Auckland Park, Johannesburg, that provides insulation products which are friendly to the environment. The product is made from spun polyester fibre which is recyclable. A life expectancy of 20 years or more are guaranteed. Labour

intensity, technology intensity and energy intensity during the manufacturing process are low. No waste products are produced during assembly. The product is easy to install and no special tools are required. The cost is from R5.00 to R14.00 per square metre. The South African Bureau of Standard estimated a 40 mm thick panel with reflective foil layer on both sides to have a thermal resistance of 0.73. Two layers of 77 mm thicknesses with an air gap has a R-value of 1.76. Sol-thermo provide poly-fibre insulation thicknesses of 40 mm in 10 m by 1.250 m roll sizes.

The “Greenhouse Project” is a project developed to encourage the development, awareness and use of environmentally responsible products. The project collected data related to this product and rated it as extremely environmentally responsible in terms of environmental impact and manufacturing process.

Resistive or bulk insulation is the best insulators. These materials trap small pockets of air within themselves, because air has a very high resistance to conduction. Insulators include poly-fibre, mineral wool, expanded polystyrene and polyurethane foam. The best way of insulating masonry or concrete walls is to affix rigid sheets of insulation to the wall surfaces, and cover them with a protective material.

Heat flow across a building envelope depend on the following factors:

- U-values of elements
- Mass insulation provided by elements
- Heat bridges (where insulation is by-passed)

Heat bridges need to be avoided. The avoidance of heat bridges allows the overall U-value of the structure to be lower. The U-value of every element needs to be considered. If an element's U-value is high, then it is a potential heat bridge that should be avoided. The insulation in a wall becomes less effective if thermal bridges connect panels. Brandering in a ceiling not covered by insulation acts as a thermal bridge and heats up linear patches on the ceiling directly below.

A high mass wall can absorb several times more energy than a lightweight construction. In direct sunlight, the high mass structure will need time to heat all the way through. The time needed to transmit heat from one surface to the other is lag time (in hours). The lag time is a benefit in thermal control when it is a hot afternoon outside, the inside surface of a high mass wall is cool due to early morning outside temperatures. When it is a cold night outside, the inside surface temperature is warm due to the hot afternoon several hours earlier. If the mass received solar radiation, the effect is much more marked. Lag time is dependent on the heat capacity of the structure. The lag time for a concrete roof slab or a 220 brick wall is around 6 hours and for a 330 brick wall up to 11 hours. High mass structures are best suited for locations where the average summer temperature falls in the comfort zone: for Johannesburg it is 23 24 C.

Mass insulation is also known as the direct heat gain passive system. Direct penetration through windows into spaces are necessary. Short wave solar radiation falls on surfaces within the space that absorb the energy and begin to heat up. As the surfaces heat up, some of the absorbed energy is re-radiated into the space as long wave infrared radiation later when the space cools down. In Johannesburg, a 20% (of floor area) solar window combined with thermal mass and insulation of low-mass elements will result in winter thermal comfort.

Ventilation system:

During summer cooling will take place by means of natural cross ventilation and stack ventilation.

Location:

The building is located within 50 m of a bus stop and one city block from the mini-taxi bus terminus, Metro Mall. People make use of public transport that saves energy and puts less strain on the environment.

Appliances and fittings:

Energy efficient fittings and devices are specified. 80% of light fittings are fluorescent or have low energy consumption (Explained in 2.1.4).

Appliance	Conventional (kw/h)	Possible (kw/h)
Fridge	1900	900
Washing machine	960	540
Freezer	1800	765

Water has a high specific heat and takes a lot of energy to heat up. Hot taps needs to be close to the geysers as possible. If there are separate sets of plumbing spaced some distance apart, separate smaller geysers save more energy, even if the installation costs higher. Pipes need to be properly insulated, as do geysers. Hot water systems are often only 60% efficient (Napier, 2000:10.3). 25% of the electricity consumed by a household heating system can leak out of the geyser due to standing losses. 15% are lost in hot water pipes. An extra insulation blanket is an investment. The instant water heater is a popular solution where high heat wastage applies. Cold water pipes need to be out of radiant sun. The pipes need to be kept in shaded routes by means of a recess or insulation.

Recycling and reuse:

Raw materials and new components used in buildings consume resources and energy in their manufacture and processes. Buildings accommodate activities that consume large amounts of resources and products and produce large amounts of waste. Reducing the use of new materials and components in buildings and in the activities accommodated and reducing waste by recycling and reuse supports sustainability by reducing the energy consumption and resource consumption.

Inorganic and organic waste:

Integrated waste management systems must be considered in South African cities. Waste is a people's problem and people have to take responsibility for their own waste. In order to be sustainable, waste management must consider the waste stream in a holistic "cradle-to-grave" manner in order to optimize the use of natural resources and reduce environmental impacts. An integrated approach, which combines several techniques such as reuse and recycling, must be considered. Local authorities have to develop Integrated Waste Management Plans for general waste. Emphasis must be placed on a phased approach to the implementation of more sustainable processes.

Cleansing (litter removal and street sweeping), as well as waste collection is the most costly components of city waste management systems. Commuters must be encouraged to take responsibility for their waste and be consulted in preparing a strategy for their area. Citizens must be made aware of and reminded of the aims and objectives of the waste strategy being implemented. When considering the collection of waste from urban areas and the transport of waste the strategy must include action plans to firstly ensure that all wastes enter the waste stream. Illegal dumping must be stopped. Enough waste bins need to be provided outside and inside the building. Sustainable landfills must be defined as waste disposal systems where air space, processes, use of products and residues are at an optimum and where minimal negative effects on the environment are detected.

Fig 252. Waste management.

Proper planning must be carried out prior to recycling programmes. The elements that need to be considered include source separation, curbside collection, material recovery facilities and mixed waste processing. Drop off points form a major part of recycling initiatives. Institutions provide necessary service and earn an income in the process. Bottle and paper banks situated in convenient spots in an urban area can work if the site is not neglected and integrated into municipal programmes with signage and litter bins available. The litter problem results in blockage of storm water inlets. The area is served by the Robinson Deep Landfill and Springfield Incinerator and recycling plant. There is a garden refuse site at Robinson Deep. The newly created agency, PIKITUP, is now responsible for waste management in the city.

Organic waste must be separated from inorganic waste by means of separate containers. Organic waste can be used to produce compost used for fertilizer. Inorganic waste must be sorted by means of a separated shaft into containers from where the waste will be removed to a recycling plant.

Sewerage:

The main interest is water conservation. The benefits of the re-use of grey water to flush toilets reduce the demand for water, an increasingly valuable source, and to reduce the energy and capacity requirements on any downstream treatment process. Grey water can be stored in a reservoir, pumped up to the roof and used for flushing. The quality of water needs to be fitted to the use. On-site treatment requires monitoring, maintenance and supervision. This is a less attractive option than local sewerage disposal, but is more sustainable.

Construction waste:

Building work results in large quantities of waste, much of which could be salvaged for reuse. Construction waste needs to be minimized. Better site management could cut over-ordering, reduce general mishandling, and improve the poor storage that renders materials useless. Although the volume of demolition waste is huge, much of it is inert, allowing it to be crushed, processed, and reused as an aggregate in road building. The concrete structure and concrete panels can be recycled to a certain extend. Pre-cast concrete with a high degree of standardization minimizes construction waste. 90 by 90 by 190, 190 by 190 by190 and 190 by 190 by 290 modular concrete blocks and modular 90 by 90 by 190 clay bricks has great value as recyclable materials. Bricks that are damaged can be crushed and recycled and returned to the manufacturing process, or used as ground cover in crushed form. Waste wood can make chipboard.

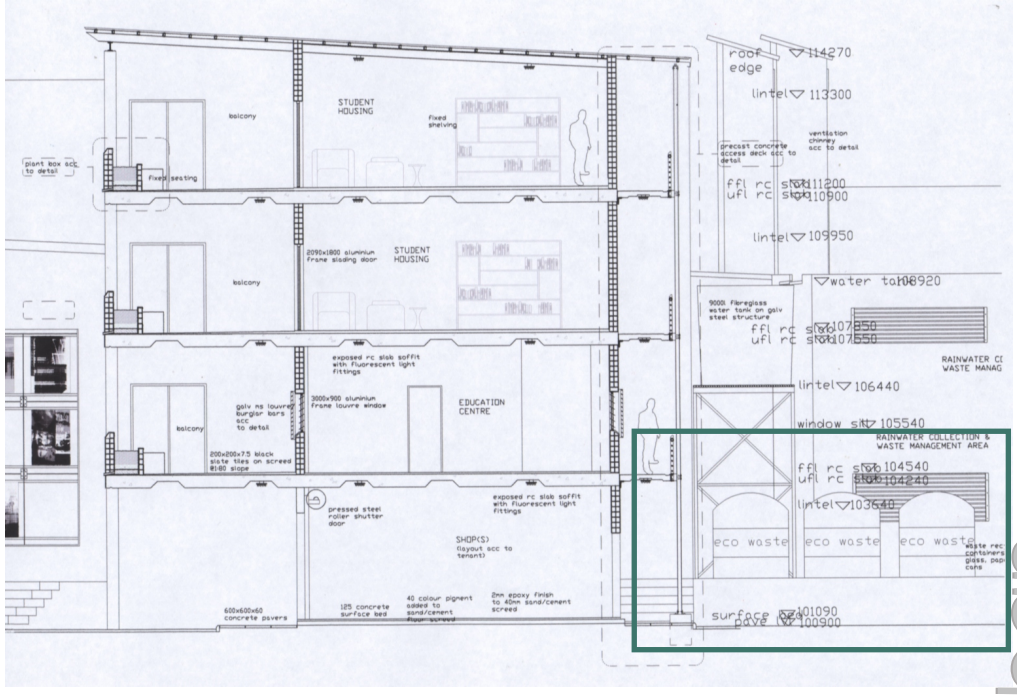


Fig 253. Waste management.

Site:

Any building has a footprint that takes up space otherwise occupied by natural ecosystems that contributes to sustainability and by maintaining an environment that supports life. The new development should be an improvement on the site by introducing its own sustainable systems.

Brownfield site:

A brownfield site is a site with little ecological value: an open piece of land where there is no real natural ecosystem. It is wasted land. The site is fenced in and does not serve any purpose currently. By placing a sustainable development, which works with nature, can only be an improvement on the current state. The new development is seen as an opportunity to repair existing ecosystems or to develop new ecosystems.

Neighbouring buildings:

The new building will not have a harmful effect on neighboring buildings in term of over shading or any other aspect. The new development can only improve the use of the adjacent Turbine Hall building, recently renovated as Johannesburg's newest music venue. The public environment links the two buildings and facilities are shared by its users.

Vegetation:

There are six million trees in Johannesburg. On satellite pictures, the city looks like a rain forest, albeit man-made. There are 1.2 million trees within the parks and on the pavements, and 4.8 million in private gardens throughout the suburbs. Pre-1994 records were kept of which trees in the city had been planted and pruned, and up to 30% of the city's trees had been monitored and counted. This programme has now been taken up again (Davie, 2002). Extensive use of vegetation will be implemented. There has to be made provision for much needed open spaces in the CBD, whether it is in the form of green soft spaces or well-functioning public spaces like the Turbine Square. Social gathering places within the urban fabric are needed. Boulevard treatment is proposed along main routes like Jeppe and West Streets. When heat rises from the tar, trees act as a natural coolant. Carbon dioxide emitted from cars is taken in by trees and converted into oxygen. Trees also reduce noise levels. The pavements have to be a little over two metres wide to plant trees. Tree-lined paths will be used on the square to define public spaces and to create a comfortable outdoor

Fig 254. The site does not serve any purpose at the moment.

Materials and components:

Buildings are major consumers of raw materials and energy resources that relate directly to environmental impacts on a global, regional and local scale. Global warming and carbon dioxide emissions due to energy usage are considered to be the most important environmental concern.

Embodied energy:

Embodied energy is defined as the energy consumed by all the processes associated with the production of a building, from the acquisition of natural resources to product delivery, including mining, manufacturing of materials and equipment, transport and administrative functions. Representative embodied energy values for different materials are produced for each country so designers can choose environmentally preferred materials.

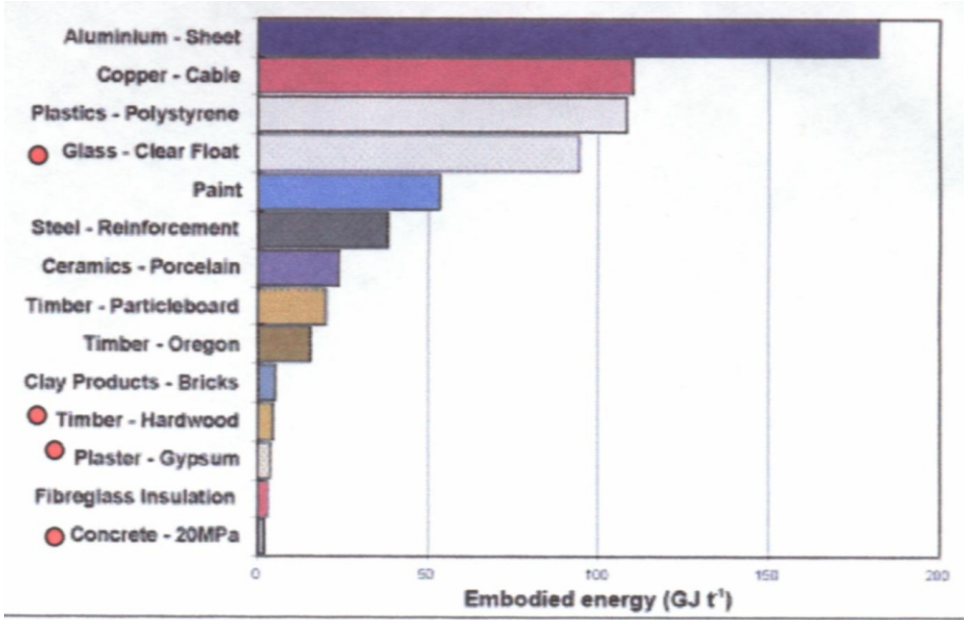


Fig 255. Embodied energy of materials.

Embodied energy graphs overlook two important issues:

- the role of design in reducing quantities of material;
- potential resource and energy benefits of material recovery and recycling.

These factors may facilitate large reductions in embodied energy without the use of unfamiliar or unsuitable materials. 80% of the building materials and components have to be made from materials with low embodied energy. Such materials include locally made and sourced timber, concrete, concrete blocks and timber window and door frames.

Manufacturing processes:

The manufacturing of materials and components must not be harmful to the environment and people. No green house gasses must be released: the least impact on the environment (pollution), the better. No toxic paints, asbestos for

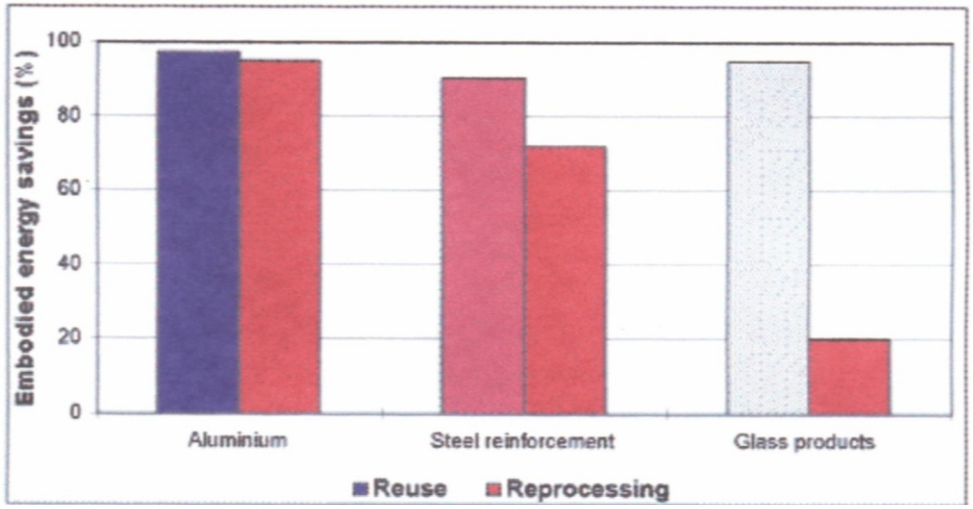


Fig 256. Embodied energy and recycling.

for insulation or blown insulation must be used. Latex paints are free from flammable and toxic solvents, and paints based entirely on plant extracts and natural oils are becoming more widely available.

The water consumed during the manufacturing process must be taken into consideration:

Material	Water consumed (l)
1 tonne of bricks	2200 l
1 tonne steel	165 000 l
1 tonne plastic	1.32 million l
Typical 42 - 45 kg Cement bag	23 l)

Recycled and reused materials and components:

Materials and components must be made from renewable resources if possible. 10% of the building's materials and components must be reused or be from recycled sources. The reuse of building materials commonly saves about 95% of embodied energy, which would otherwise be wasted. Some materials such as bricks and tiles, suffer damage losses up to 30% in reuse. If materials were recycled at the end of their useful life in a specific application, the energy that would have been required to process the same product from raw material would be saved. The savings by recycling materials for reprocessing varies considerably with savings up to 95% for aluminium but only 20% for glass. Long transport distances to recycling plants use more energy. The use of recycled steel reinforcing, concrete from an energy-efficient plant and optimal slab design may reduce the embodied energy for the concrete slab. Standardized materials, easily separated parts and information from suppliers ensure recycling. Avoid redundant structure. Do not skimp on insulation and double-glazing: these materials have low embodied energy compared with operational energy savings.

Water:

Water is required for many activities. A reliable water supply is essential to any development. The large-scale provision of conventional water supply has many environmental implications. Water needs to be stored (sometimes taking up large areas of valuable land and disturbing natural drainage patterns with associated problems from erosion), it also needs to be pumped (using energy) through a large network of pipes (that need to be maintained and repaired). Having delivered the water, a parallel effort is then required to dispose of this after it is used (sewerage systems). Reducing water consumption supports sustainability by reducing the environmental impact required to deliver water, and dispose of this after use in a conventional system. The quality of the water must always be matched with the usage.

Rainwater:

Rainwater is a source to be utilized in a building. The sizing of gutters is based on the area to be drained and the maximum recorded rate of rainfall at the particular location. The highest recorded 24 hour rainfall (mm/hour) in Johannesburg is 188mm/24 hours.

R = rate of rainfall = 0.31 inch/hour

Gallons/minute (gpm) = A (sqr ft)/96 * R (inc/hr)

R = rate of rainfall = 0.31 inch/hour

Gallons/minute (gpm) = A (sqr ft)/96 * R

= 14902 / 96 * 0.31
= 48.12 gpm

1 gpm * 0.0631 l/s

48.12 gpm = 3.03l/s

If it rains for 1 hour at a rate of 188mm/24 hours, a total of

(0.03 * 3600s)
= 10 908 litres can be collected from roof surface.

15 l /person / day is needed in high quality, low cost housing. This same amount will be used by the 20 students per day. Each shop will also use 15 l/ day.

20 students = 20(15) = 300 litres (Gibbert, 2002)
5 shops = 5(15) = 75 litres

375 litres can be provided by the rain collected from roof surface A1. This water will not be fit for drinking after filtration, only for washing purposes.

A water efficient dual flush toilet will not use more than 6 l per flush.

If approximately 375 litres of grey water is produced, each toilet will have 62.5 l of grey water to flush it. This equals 10 flushes.

Storm water can be ultimately be discharged into municipal storm sewers. If a storm sewer is not available, water may be allowed to soak into the ground. This is only possible if the soil is permeable enough to absorb water at a sufficient rate. Planting over a site can increase the natural soakage into the ground. Rainwater must rather be collected for general building use. Storm water collected from roof surfaces may be filtered and stored in an urban reservoir (cistern) for later use. If the reservoir is elevated above the end use, water may be supplied simply by the flow of gravity. Otherwise, a pump is needed.

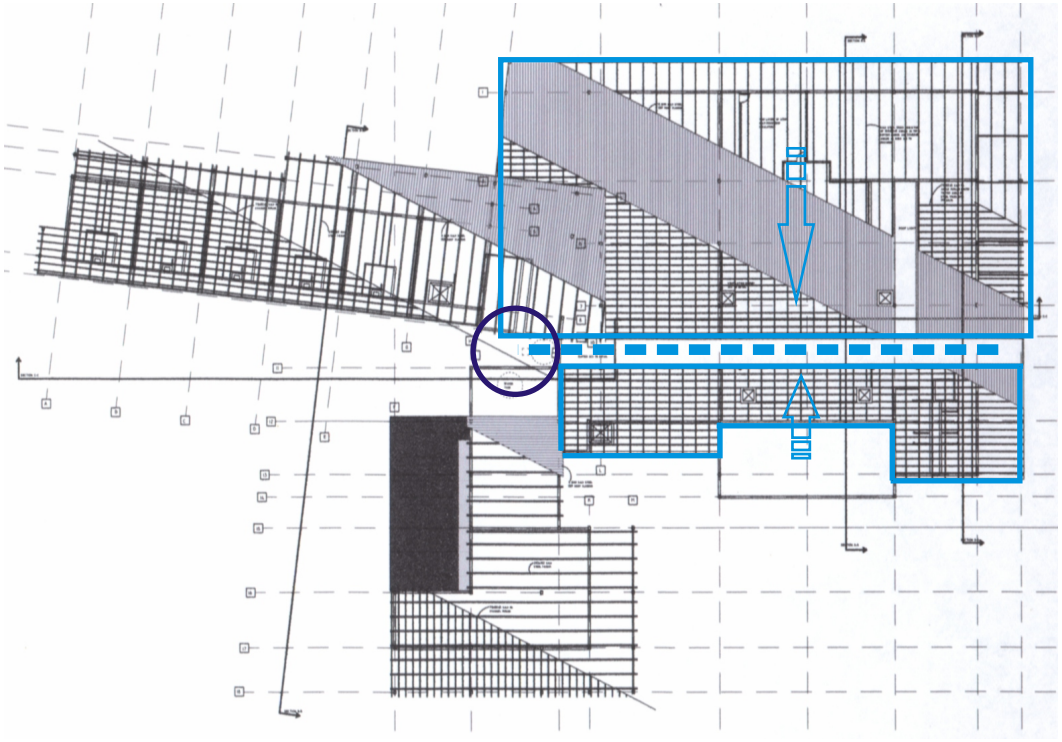
The volume of water able to be captured by a reservoir (V) can be calculated:

V (cubic m) = R (cm/hr) A (m) t (hr) V = 0.78 * 1384.95 * 1

100cm/m 100

V = 10.8 cubic metre 1 cubic metre = 1000 litres

The reservoir must hold 10 802 litres of rain water.



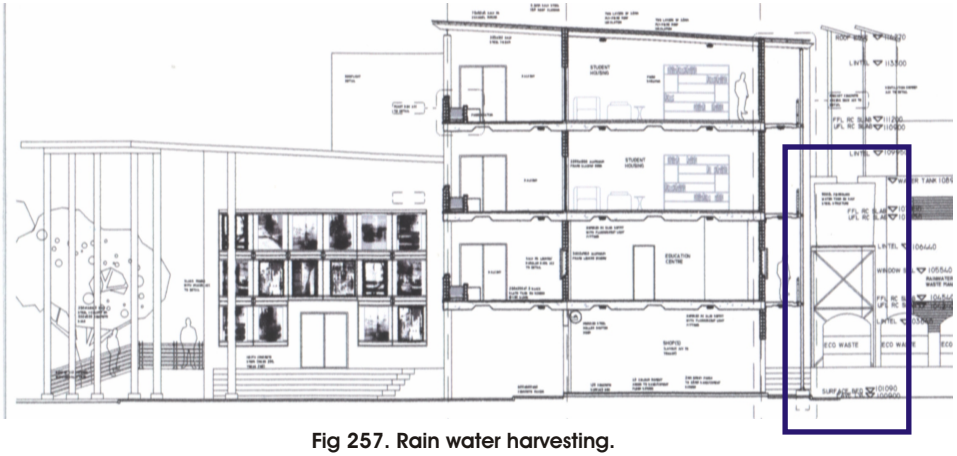


Fig 257. Rain water harvesting.

ECONOMIC ISSUES:

Economic profile of Johannesburg:

Economically, the city generates a Gross Geographic Product of R 86 billion, 16% of South Africa's GDP (40% of the Province), providing jobs to 840 000 people (12% of national employment). Economic growth has averaged at 2% per annum over the last ten years, slightly ahead of the national average of 1.8%, with employment growing at just under 1% per annum over the same period. Yet unemployment has risen from 27% to 30% over the last three years.

Economic output and employment in the city is generated from the four key sectors of financial and business services, trade (retail and wholesale), manufacturing and community and social Services.

Overall investments increased on average by 2.6% per year from 1990 to 1999, although taking a dive in 1998/99 of - 3.8%. Transport and communication (+154%) as well as retail/wholesale (+35%) have experienced the highest investment growth rates over the last ten years. Electricity (-17%) and construction (-14%) have seen the sharpest decline in investments over the same time period. Investment ratios (new investment/capital stock) have risen for the main services sectors, whereas for the manufacturing sector the ratios went down.

This leave Johannesburg with a very high level of exposure to a few major sectors, three out of four being service sectors. This pattern in the economy of the city is the result of ongoing restructuring processes that have seen successive waves of development and decline in key sectors over the history of the city. The last decade has seen the strong emergence of the services sector, particularly financial and business services, the restructuring of manufacturing in

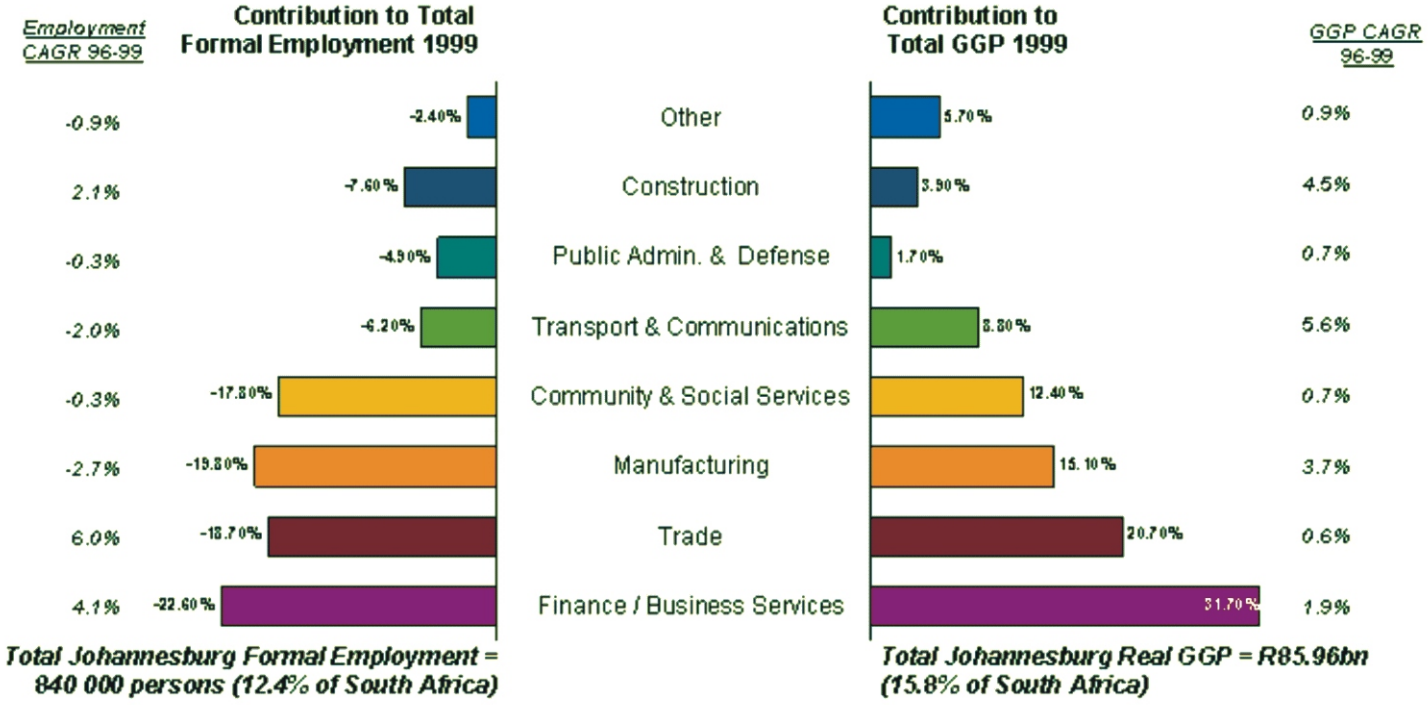


Fig 258. Economic profile of Johannesburg.

response to the opening up of the economy, and the emergence of the new, knowledge-based economy where the real assets are in the form of skilled people and knowledge - both forms of capital that are highly mobile.

These trends are not about the local economy within the borders of the city alone. In the particular case of the manufacturing sector, Johannesburg is a part of a widespread manufacturing cluster running from east to west along the central Highveld. While Johannesburg may well be the place where more high-value added activity is located, the questions relating to manufacturing are questions not just for the city, but also for the Province as a whole and for the East Rand particularly.

The legacy of apartheid is that Johannesburg is a deeply polarised city characterised by inequality. The affluent white population (less than 20% of the population), live mainly in the suburbs of the north and, have a standard of municipal infrastructure and services usually reserved for the wealthiest of developed country cities. The generally poor African population (about 70% of the population), live mainly in the large urban townships of the south and the peripheries of the north. The many years of neglect of the needs of these areas now present a grave crisis to the city. The Human Development Index (HDI), which is a composite, relative index based on measures of life expectancy, literacy and income, differs markedly by population groups within the city.

In order to reduce unemployment to 6% equalling 97 000 people (considered "full employment") by 2010, Johannesburg needs 3.5% p.a. job growth in the formal sector, or a total of around 475 000 new jobs in the next 10 years. Job growth at the current 1.1% p.a. will leave a deficit of around 440 000 jobs, i.e. which will still leave an unemployment rate of 27%. Johannesburg's vision aims for prosperity for its residents. To reach the levels of prosperity that middle income countries like Argentina and the Czech Republic have attained, Johannesburg would have to experience a steep increase in its GGP/capita growth rate, which has been flat since 1996.

At the same time as (and partly because) the economy of the city has undergone restructuring in response to global pressures and has seen the emergence of the new smart, knowledge industries, informal business activity has grown dramatically as a source of income to residents in the city. Overall, between 1996 and 1999, employment in informal enterprises has grown from 86 310 jobs (9.6% of total employment) to 161 000 jobs, or 16% of jobs, with most of this growth generated in the trade, community services, construction, and manufacturing sectors. Trade (largely retail) remains by far the largest sector for informal employment, with incomes being generated still very much at subsistence levels. National data on the informal economy suggests that half of informal incomes are below R 222 per month.

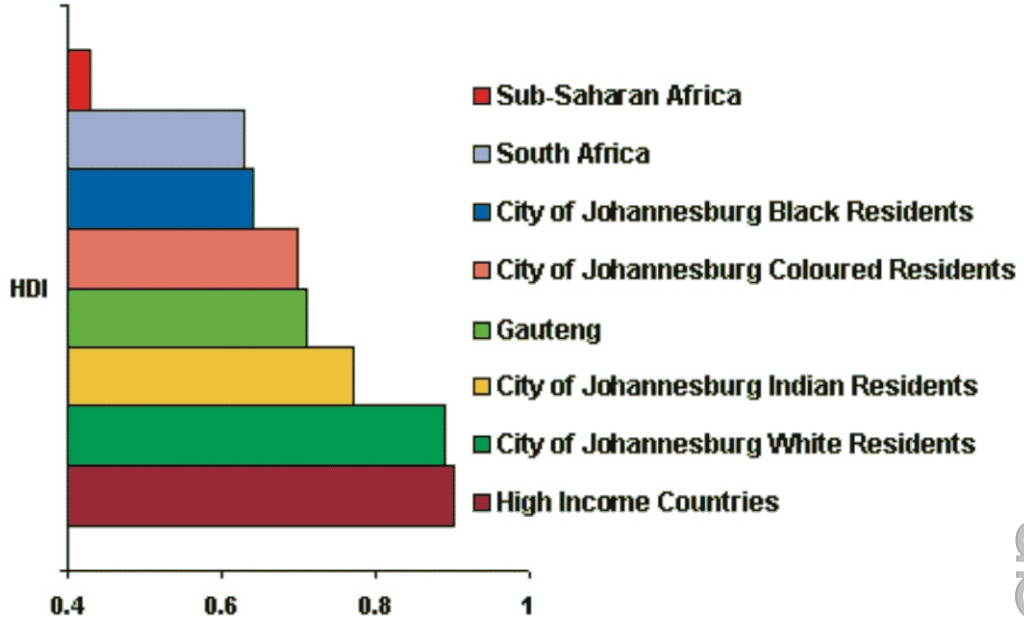


Fig 259. Poverty in Johannesburg.

In the "Joburg 2030" Integrated Development Plan (IDP) the vision for the future describes Johannesburg as a "better city." This normative concept is concretised to read as: " a sustainable increase in the standard of living and a sustainable increase in the quality of life for all the city's residents." This outcome will be measured by increases in GGP per capita and Human Development Index (HDI). Sustainable growth will support increased disposable income, and increased tax revenues for the council which in tern will support HDI related projects. The key question in the development of this concept was- "how does a city go about increasing GGP growth?" The answer to the question was found in returning to micro-economic principles.

Sustainable GGP growth for a city can best be founded by harnessing economies of urbanisation and increasing total factor productivity. This implies that the city must concentrate on increasing the factor productivity of key inputs such as labour, transport, commercial space, services and supply chains as well as increasing the productivity of the inputs interacting with one another. A city operating as an effective and efficient economic
entity will be a necessary condition for increased growth. Besides generically increasing the city's economic efficiency, it must also support efficiencies for key specific sectors. This is known as economies of localisation. Where key sectors can be identified, the city should seek to develop economies of localisation (Johannesburg City Council, 2001).

Fig 260. The living standards of Johannesburg's citizens must be improved.

The cost of a building:

Inevitably all design decisions of a building have cost implications; the shape of a proposed building, the construction materials and the method by which it is to be built will ultimately determine its cost and its expected cost may determine whether it will be built at all. Furthermore, when it is completed and in use, its design will have important, perhaps predominating effects on the cost incurred in using it, as well as the effectiveness with which it can fulfill the purpose of its users.

People who are committing large amounts of capital to invest in buildings expect value for money. But what is value for money? A building which is seen by passers-by, neighbours or visitors, as excessively ugly and perhaps oppressive, may be what the client wanted: it may have been cheap and it may allow activities within to proceed efficiently. There are questions to be asked about the negative values that it hold for the local community. Social values may imply higher expenditures. One has to judge value in terms of the ultimate benefit to the society.

A building's cost, that is the total resources necessary, depends on:

- its size, shape and construction method;
- the amount and type of materials used;
- the cost of human resources involved in design and construction;
- the cost of machinery and tools;
- the efficiency and the integration of the design, procurement and construction;
- the effectiveness of the design in allowing efficient, low-cost use of the building when completed (Morton and Jaggar, 1995: 49).

Local economy:

Buildings cannot be conceived solely as beautiful objects in space. They are part of any country's fundamental economic resources. The construction and management of buildings can have a major impact on the local economy. Johannesburg has a rich history of developing and implementing sophisticated and advanced programmes, which deliver economies of localisation. Unfortunately these economies of localisation are in place for heavy, primary production sectors, most especially the gold mining and iron and steel industries. As these industries decline and their contribution to GGP and employment growth decreases, so the economies of localization present in the city become more outdated. An analysis of existing activity in the City clearly showed that the economic trajectory of the city's economy rests firmly with the service sectors rather than the productive sectors of the economy. The dominance of services bodes well for the city. First high value adding activities and especially the service sector sits well the city's existing cost structure, which is higher than other metropolitan areas. Second international demand for services exceeds the demand for goods hence the export opportunities for the city fit well with global demand trends. The challenge in growing this sector will be the ability to generate sufficient and appropriate skills within the labour force and to upgrade information and telecommunication systems. The local economy must be stimulated and sustained by buildings that make use of local resources: local skills and local materials.

Local contractors:

The contractor has a difficult task in controlling cost and producing a building of quality within a specific budget. Even for efficient contractors there will be inevitable delays and difficulties with the site, late deliveries, unavailable and poor materials and problems with sub-contractors. 80% of the construction must be carried out by contractors based within 40 km of the building. If problems occur, there is no unnecessary traveling. By using local contractors and labour, a local

Fig 261. Local small businesses must be supported.

a local skills base can be created that can be drawn of for maintenance of buildings and services. People can be trained in the necessary skills to develop a strong diversed local economy where money is recycled. The level of production in construction operations depend upon:

the intensity of work;
the type of work;
technology used.

If people are trained in the appropriate skills, a high level of productivity can be reached. At design level it must be clear that labour requirements should be realistic in terms of the skills available and ways in which labour can be effectively employed. A project that offers continual employment for particular trades, rather than intermitted, will have several advantages:

- it will enable employing contractors to use workers more efficiently and therefore less expensively;
- it is more likely to generate a sense of commitment to the job from the people employed;
- shared pride in the work is a powerful force of quality.

Costs can be held down through pressure on payments from competitive forces and low tenders; these keep rates down and output up but often at the cost of quality.

Local building material supply:

Improvements in packaging and transport, and the lowering of protective tariffs, have opened up the materials market to international competition on a large scale. Local materials are better for use from a sustainable point of view: a foreign material may be cheaper than a home-produced equivalent at one time but be suddenly priced out of market by changes in exchange rates. The availability of foreign-made substitutes creates further problems when components need to be repaired or extended. Materials can be easily sourced if bought locally. The money spent in foreign materials leaves the local system and money is not recycled. This money could rather have been spent locally to strengthen and build a diverse local economy. 80% of construction material: cement, sand, brick etc. must be produced within 200km of the site. This minimizes the cost and energy consumption on transport. Using local material provides a "check and balance" by ensuring that environmental damage that results from supply of materials is experienced locally.

Local component manufacturers:

80% of building components like windows and doors must be produced locally within 200 km. This includes furniture used in the building.

Repairs and maintenance:

All repairs and maintenance required by the building must be carried out by local contractors within 200 km of the site. The same reasons are valid as for the provision of local materials.

Efficiency of use:

Buildings cost a lot of money to build and require a great deal of resources. Effective and efficient use of buildings supports sustainability.

Usable space:

Buildings can be seen as the conversion of resources. Basic resources are being converted into materials that in turn are being converted into building components. These components form the spaces of the building. Sustainability supports the concept of waste reduction. Spaces must be used as efficiently as possible to avoid any additional building space and the waste of any resources in the cycle.

Non-usable space such as water closets, storage and circulation does not make up more than 20% of the total building area. Circulation areas are approximately 12% of the total building area. A high number of people/m must be achieved. Certain spaces are shared, like self-catering facilities and bathrooms.

Occupancy:

Buildings can be grouped under two main headings:

- Continuous use (Student housing);
- Intermitted use (Shops).

Occupancy patterns are never fixed during the life of a building and significant change in activities can occur which will have an impact on energy consumption. Spaces should be occupied for an average equivalent to a minimum of 30 hours per week. The building will function as a community center of sort that caters firstly for the immediate and direct users of the area. The ulilisation of the building should not only be diverse in users and function, but also in the times of utilization. The development will provide a "drop-in-theatre" service during different times of the day. A range of events and activities will be held, from performances, to programmes involving the youth, adults, the elderly and the disabled. Students will attend courses while accommodated in the student housing. Adult education training classes will be held during evenings. The uses in the building would be of such a nature that it would facilitate a 24-hour use of the building.

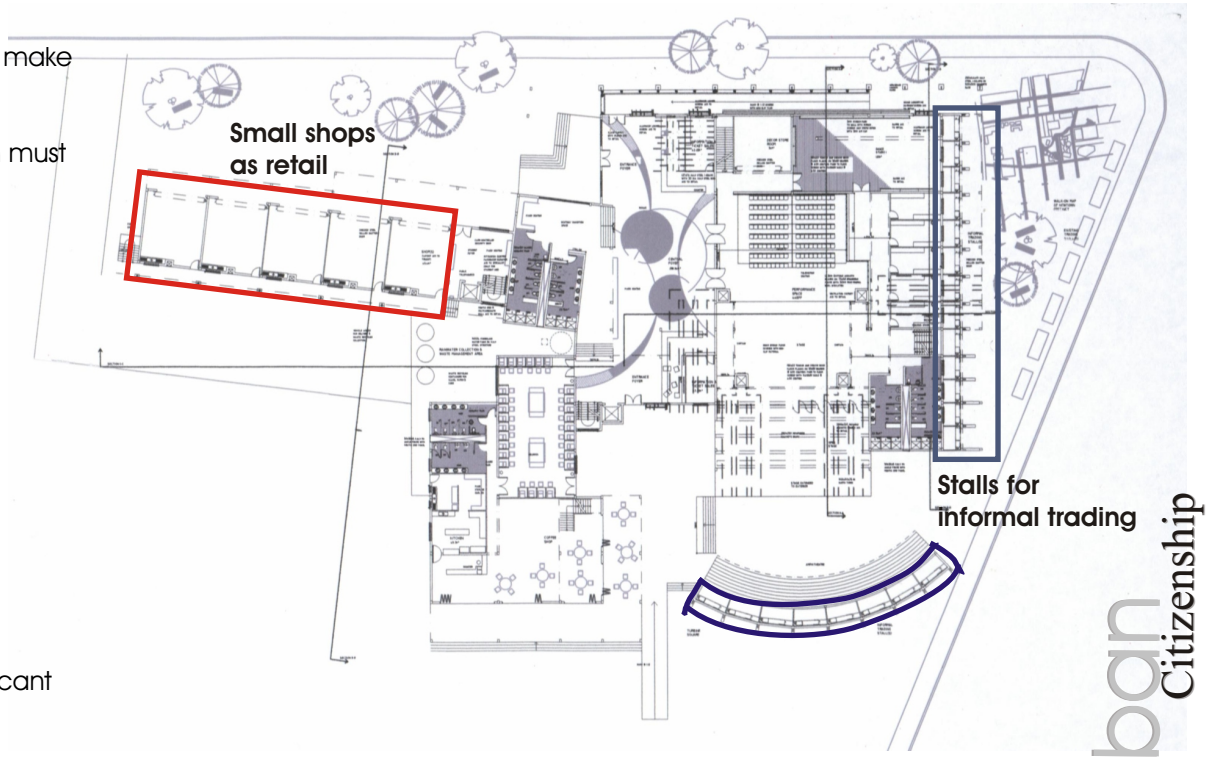


Fig 262. Development of the local economy.

Adaptability and flexibility:

Building spaces that can accommodate a wide variety of uses are described as flexible and adaptable to multiple uses. Most buildings can have a life span of at least 50 years. It is likely that within this time the uses of the building will change. Buildings, which can accommodate change easily supports sustainability by reducing the requirement for change, which involves unnecessary energy and costs. If an existing building can be renovated and reused, a new building does not have to be building. This saves money and resources. We need to design buildings with a flexible grid, flexible density, flexible space and flexible systems.

Bleacher seating (telescopic seating) will be used in the performance space. As the building concepts of today continue to expand, so too does the challenge of creating the seating solution. Many multi-use facilities continue to take advantage of telescopic seating for its overall flexibility. There are different designs: individual plastic or upholstered platform chair seating, traditional bench style seating, fixed or suite seats. When the desire is for a warm and natural appearance, wood seats and risers are the perfect choice. All wood materials start with solid, finger-jointed yellow pine with clear polyurethane finish.

The auditorium chair offers the comfort and stability of a fixed auditorium chair with fully upholstered seat and back. The back folds to the rear to allow the platforms to telescope.

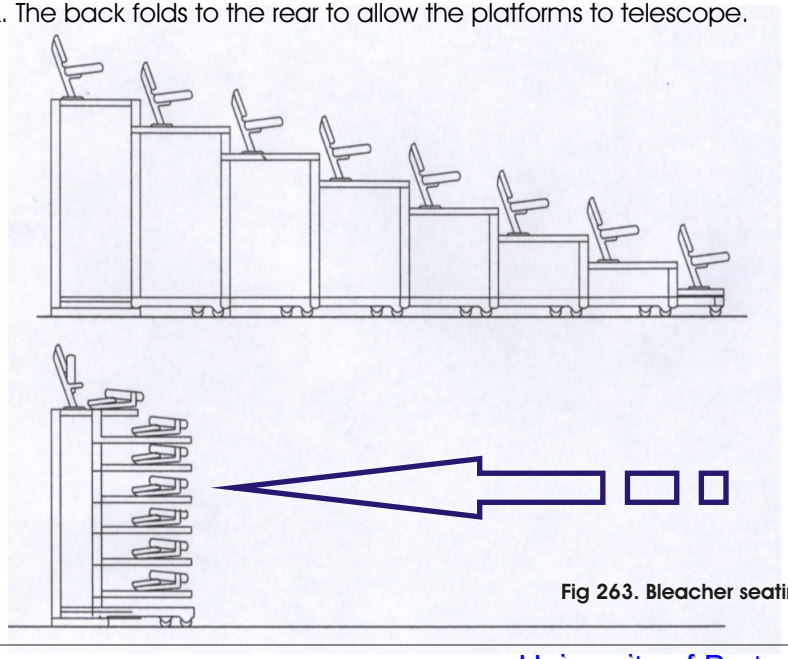


Fig 263. Bleacher seating.

Fig 264. Bleacher seating.

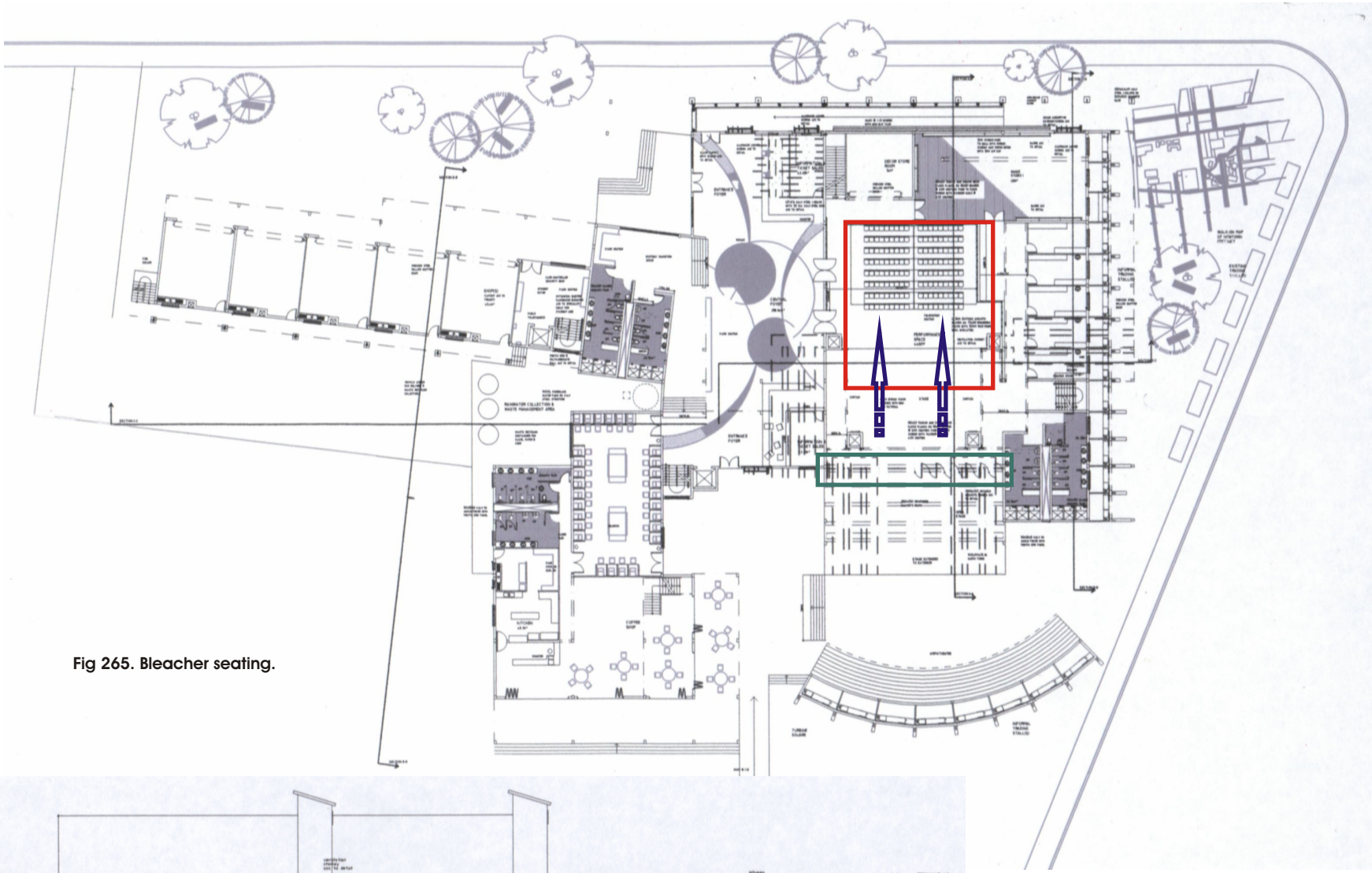
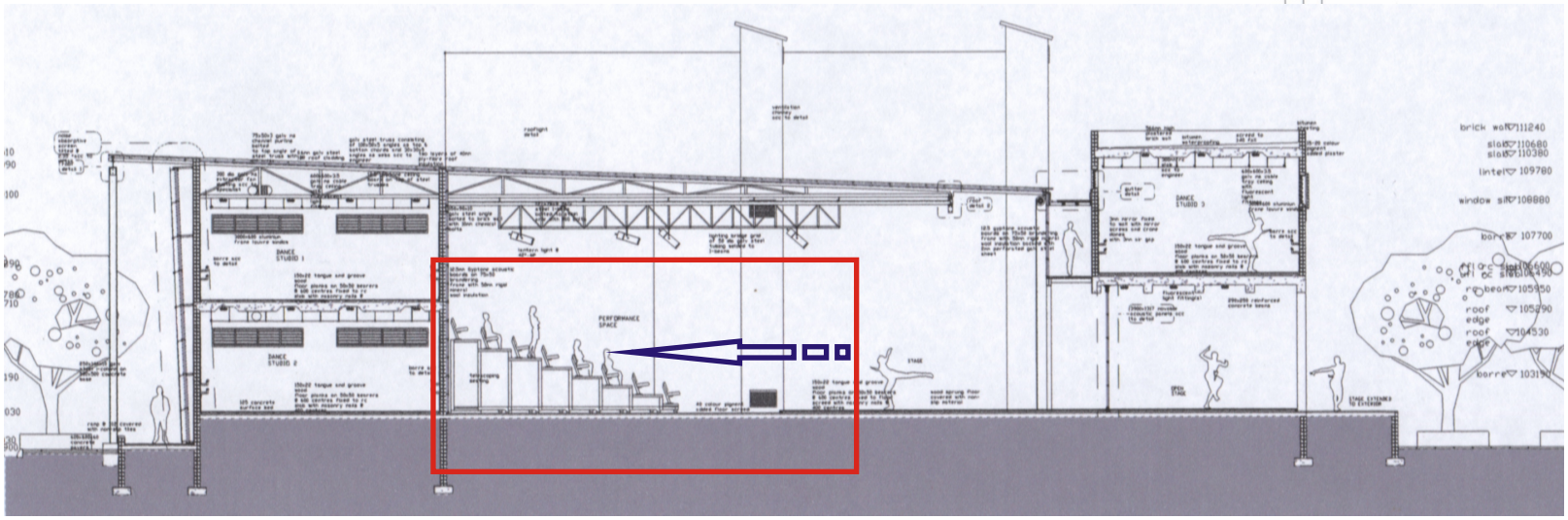


Fig 265. Bleacher seating.



Vertical dimension:

The structural dimension (distance of floor to underside of slab or roof structure above) should not be less than 3m. This vertical dimension allows for a range of uses to be accommodated within the space.

Internal partitions:

Internal partitions between living and workspaces must be non-load bearing (bricks, concrete blocks, plasterboards or composite panels) that can be easily "knocked-out". This is necessary for the adaption of spaces to new uses in the future of the building. Internal partitions can also be mobile or movable on mounted tracks to be removed when necessary.

Services:

Electrical and communication services need to be designed to provide easy access in each usable space. Provision must be made to enable easy modification of a system if the load on the system is being increased. A grid provides an infrastructure of service, and the nodes can be relocated by each user. If you want to increase the density of users, you have to make sure that the grid can support it.

Ongoing costs:

Quality is a word which encapsulates many different characteristics: aesthetics, efficiency, and durability. One can imagine an ideal situation where the different criteria were carefully considered, weighed in relation to others and a decision reached which in some sense was "optimal". Durable, high quality materials may be more expensive, but they have less maintenance and the ongoing costs are lower.

Maintenance:

Materials with low cost maintenance must be specified. All fabric must have a maintenance cycle of at least 2 years. Low or no maintenance components must be selected. Maintenance can be carried out cost effectively (i.e. replaceable items such as light bulbs can be easily reached and replaced). Materials like off-shutter concrete, steel and brick are low maintenance.

Cleaning:

Measures must be taken to limit the requirement for cleaning. Hard wearing solid flooring (limited or no carpeting) are specified, like high quality tiles, recycled brick and woodsprung floors in the studios.. Windows are easily accessible for cleaning. Details must be protected from weather conditions like rain.

Security and care taking:

Measures taken to limit the requirement and costs of security. This should include mixed-use development where the building is used 24hours a day. Buildings and spaces are overlooked by occupied neighbouring buildings. A busy place is always a safe place.

Insurance, water, energy and sewerage:

The costs of insurance, water, energy and sewerage must be monitored. The consumption and costs must be regularly reported to The management and users of the building by installing metres or pinning up a gigital printout in the entrance. Policy and management must be implemented to reduce consumption.

There are extra costs involved in providing features which save energy and there

are savings resulting from the lower energy use and other benefits such as increased comfort. A simple equation (or rather an inequality) is given:

C= the costs of energy savings;
B = the benefits derived from it.

An energy-saving measure is worth while, then, if:
C < B
But C consists of:
- the capital costs of the measure (for example the cost of insulation or a more cost efficient device);
- the cost of maintenance;
- the cost of replacement;
- any associated costs (like loss of rentable space or increased costs of energy management).
B consists of:
- the saving of costs of fuel;
- increased levels of comfort;
- other benefits (like lower levels of sickness, fewer tenant complaints in rented spaces) (Morton and Jaggar, 1995:245).

The economic attractions of passive energy-saving design appear superficially to be overwhelming; in effect most of the environmental control is provided without using expensive fuels, the sources of heat, light and cooling are free - simply the sun and fresh air. The negative effects of fossil fuel use are avoided.

"There ain't no such thing as a free lunch" (Dolan, 1971: 34)

This principle bears some resemblance to the costs involved to lower energy usage. Much of the actual material needed to improve energy efficiency by passive design methods will certainly involve cost over and above what would be incurred in a conventional building, such as extra insulation or extra shutter.

In a study published by the *Architect's Journal* in January 1994, Davis Langdon and Everest identified the costs of some twenty different ways of achieving the currently required U-value for exposed walls in dwellings of 0.45 W/ square m. K. Their study shows that there is very little difference in cost between the three main systems, full cavity fill, partial cavity fill and internal insulation; but quite a wide range between different specific methods in each group. There are no direct relationship between cost and the effectiveness of insulation. High levels of effectiveness can be achieved with little or no extra expenditure.

Disruption and "downtime":

Electrical and communication services must be located where they can be easily be accessed with a minimum of disruption to the occupants of building: maximising access to this from circulation areas (rather than work/living areas). Lift-off panels at regular intervals to vertical and horizontal ducting must be provided.

Capital Costs:

Buildings are generally one of the most valuable assets that people, and often organisations and governments own. Often too, the high cost of buildings results in the services, like education and health, and the accommodation are beyond the reach of people with the lowest incomes. A large portion of Johannesburg's population suffers from poverty, as seen in the city's economic profile. Buildings that are cost effective support sustainability by helping provide access to accommodation and services for low income areas and by enabling money to be spent on other areas that

One must always relate the short-term to the long-term costs - that is, in the context of the building, the capital costs of construction with the running costs over the building's useful life.

Consultant fees:

Consultant fees must not only be calculated on the total project cost basis: incentives must be provided to consultants to reduce capital cost and ongoing costs.

" The engineering of buildings to provide an acceptable environment for occupants, to a price . . . Needs to be precise; this requires dependable modelling especially for passive cooling; if the engineering of a cooling service system is wrong first time it may be relatively easy to resize a fan or pump or tweak controls. If the form and fabric of a passive building is wrong, resizing may be impossible . . . Liability is a real issue here (Evans, 1994: 34).

There is a high cost in the design process itself. Design expertise has to be paid for. Several computer programmes are used to design passive systems successfully. It may well be worth while to pay for such services for it should be outweighed by the benefits both in energy savings and of lower costs in use for users and owners of the building. It is a cost which cannot be ignored or skimped.

Build-ability:

The building should be designed to be easily and cheaply built. Building form must avoid complex design. There must be consideration for the technicalities of constructing individual elements of the building, of the junctions and interfaces between elements and sub-assemblies. Elements and components must be replicated where possible. A building can be designed to be build-able, but the designer may not have fully appreciated the range of skills needed for its effective execution and may not have matched the design requirement with the capacity of the particular contractor to supply the necessary skills. The contractor on the other hand may not be sufficiently flexible to adapt his or her approach to the requirements of the design. The only way around this is better consultation at the early stage of design. Unfortunately, the competitive tender system as it is operated in many contexts today not only discourages but does not even allow the necessary fertilization of ideas at an early stage. This is one of the reasons for adopting a procurement method which brings a designer and contractor together before the design has to be determined in detail (Morton and Jagger, 1995: 286).

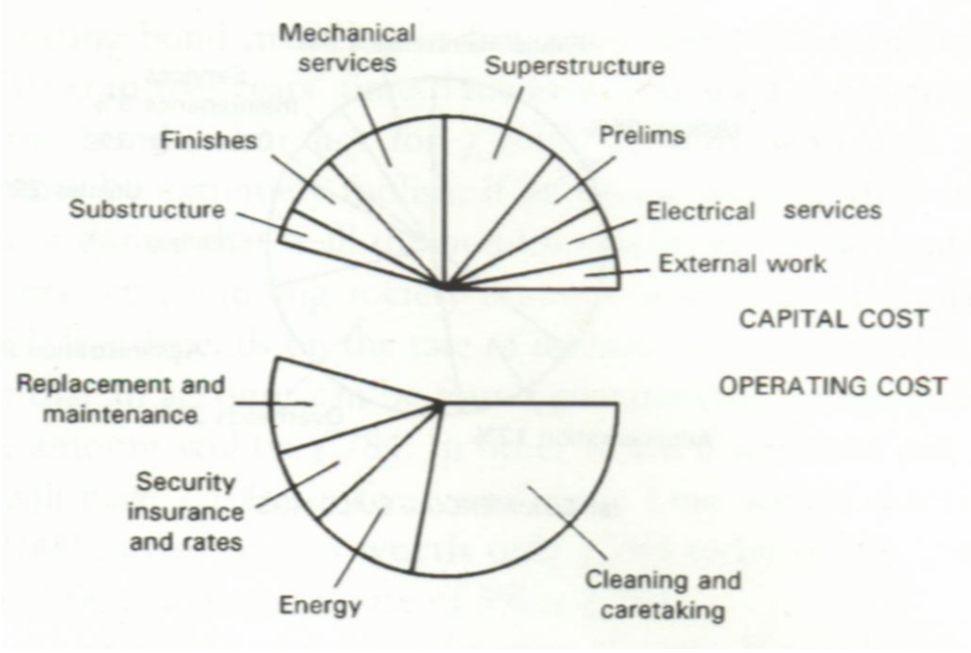


Fig 266. Capital costs and ongoing costs.

In his *Practical Buildability, based on the work done for the CIRIA report, Buildability: an Assesment, Steward Adams suggests a check-list of "buildability-factors" :*

- Investigate thoroughly: site and other conditions which might affect progress.
- Consider access at the design stage.
- Use suitable materials.
- Design for the skills available.
- Design for simple assembly.
- Plan for maximum repetition or standardization.
- Maximize the use of plant.
- Allow for sensible tolerances.
- Allow a practical sequence of operations.
- Avoid return visits by trades.
- Design for safe construction.
- Communicate clearly.

Construction:

The construction approach must be designed to reduce initial capital cost of the building. The building can be undertaken in a series of phases. The building can be built as the shell first with finishes to be added later. To achieve an energy efficient building requires that energy conservation should be fundamental part of the design brief prepared by the owner or developer. The potential to save energy is the highest during the inception of a project while the cost to implement this is very low. As the project progresses the potential diminishes while at the same time the cost to implement energy conservation strategies increases.

Sharing arrangements:

The size of spaces within the building can be reduced through arrangements to use existing spaces in nearby buildings. The performance facilities of the adjacent Turbine Hall can also be used for large performances.

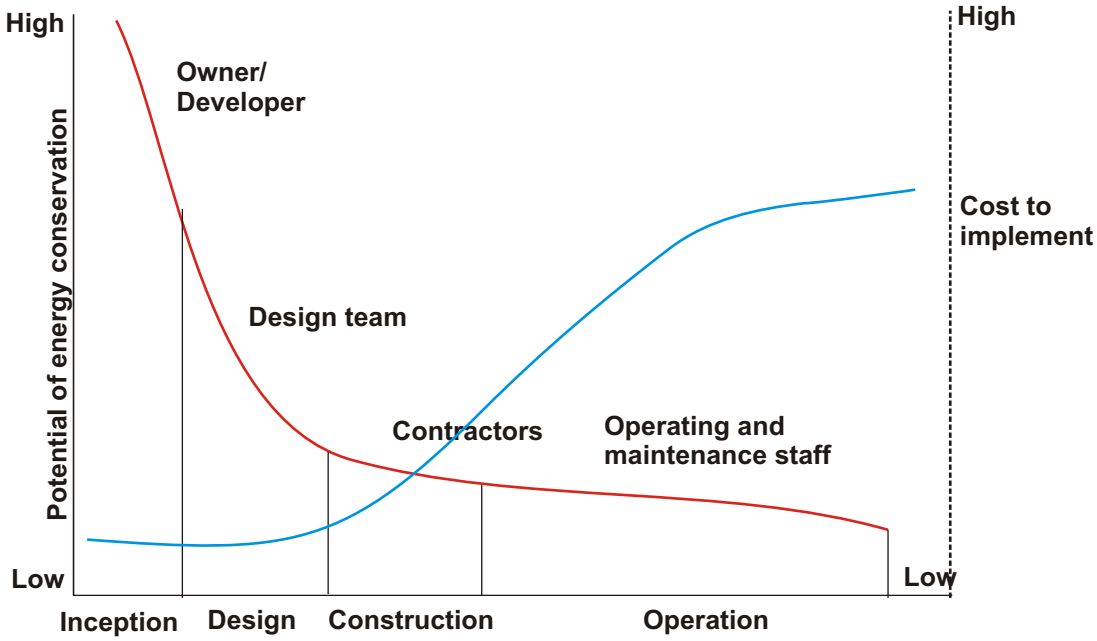


Fig 267. Stages in the life of a building.

List of referred works:

• ADLER, D. 1994. *Metric Handbook. Planning and Design Data. Architectural Press. New York.*

• ALSWANG, J and VAN RENSBURG, A. 1984. **An English Usage dictionary for South African Schools.** Johannesburg: Perskor.

• AMIS, J and Rose, M. **Words About Music: An Anthropology.** London: Richard Clay.

• **An Analysis on Open Space in Greater Johannesburg.** 2000. Http://www. Cerio.net/reports/johannesburg/csoe/parks and open spaces/open space/analysis.htm (24/02/03)

• **An Analysis on Solid Waste in Greater Johannesburg.** 2000. Http://www. Cerio.net/reports/johannesburg/csoe/solid waste/waste/analysis.htm (24/02/03)

• **An Analysis on Total Pollution in Greater Johannesburg.** 2000. Http://www. Cerio.net/reports/johannesburg/csoe/total pollution/pollution/analysis.htm (24/02/03)

• **An Analysis on Waste Water in Greater Johannesburg.** 2000. Http://www. Cerio.net/reports/johannesburg/csoe/waste water/water/analysis.htm (24/02/03)

• ANDERSON, J. 1974. **Dance.** New York: Newsweek Books.

• BAKER, G.H. 1996. **Design Strategies in Architecture. An Approach to the Analysis of Form.** New York: Van Nostrand Reinhold.

• BAMBANANI CONSORTIUM. 2001. **Local Integrated Development Plan: Region 8.** Johannesburg: Johannesburg Metropolitan Council.

• BARBA,E and SAVARESE,N. 1991. **A Dictionary of Theatre Anthropology.** London.

• BENTLEY et al. 1985. **Responsive Environments.** London. The Architectural Press.

• BRADSHAW, V. 1992. *Building Control Systems. John Wiley & Sons Inc. New York.*

• BROWN, G, Z. 1982. *InsideOut. Design Procedures for Passive Environmental Technologies. John Wiley & Sons Inc. New York.*

• BYERS, P. 1972. **From biological rhythms to cultural pattern: a study in minimal units.** Ph.D. Dissertation. Columbia University.

• CASTELLS, M. 1996. **The Rise of the Network Society.** Oxford: Blackwell Publishers.

• **Cato Manor Development Project.** 2002. Http://www.cmda.org.za.htm (10/10/2003)

• City Development Plan 2001/2003. 2002. **A developmental overview of the City.** Http://www.johannesburgnews.co.za/budget_2003/development.htm (02/02/03)

•**CMDA Sustainability Report 2002.** 2002. Http://www.cmda.org.za/social development.htm (10/10/2003)

•COLLINS,R. 1989. *Essential English Dictionary. William Collins Sons. London*

• CORRY, P. 1980. **Community Theatres.** London: Unwin.

• **Dance Factory.** 2002. Http://www.jda.org.za/Newtown/Current_projects/DF.html (24/02/03)

- DE SAYSMAREZ, M. 1964. **Basic Design: The Dynamics of Visual Form.** London: **Hebort Press Ltd.**
- ESKOM. 1993. **Statistical Yearbook, Electricity Supply Commision.** Meggawat **Park.**
- EYBERS, J. 2003. **Voorstad in JHB herwin eertydse glorie.** Beeld, **March 23, p.1.**
- FLINT, A. 1998. **Nyanga Junction: Responding to Community Needs.** South **African Architect, April 199**8**, p45 - 50.**
- **Folding Bleacher Company: Folding Bleacher: Telescopic Seating. 2003. http://www.foldingbleacher.com (04/06/2003)**
- FUCHS, R. J. 1994. **Mega-city Growth and the Future.** Tokyo.
- GAPP Architects and Urban Designers. 2001. **The Newtown Urban Design Framework.** Johannesburg: GAPP Architects and Urban Designers.
- GAPP Architects and Urban Designers. 2001. **The Newtown Cultural Precinct Plan.** Johannesburg: GAPP Architects and Urban Designers.
- GARSON, P. 2002. Joburg. **New musical life for Turbine Hall.** Http://www.joburg.org.za/TH/index.htm (24/02/03)
- GIRARDET, H. 1996. **The Gaia Atlas of Cities: New Direction for Sustainable Urban Living.** Gaia: Stroud.
- GOODRIDGE, J. 1999. **Rhythm and Timing of Movement in Performance. Drama, Dance and Ceremony.** London: Jessica Kingsley Publishers Ltd.
- GRAHAM, J. 1996. **Witwatersrand Street Guide.** Cape Town: Struik New Holland Publishing.
- GRUNDLING, G. 1999. **Piece of the City.** South African Architect., June 1999, p.12 - 17.
- HALL, E. T. 1983. **The Dance of Life.** New York: Doubleday.
- HAUPTFLEISH, T. 1997. **Theatre and Society in South Africa - Some Reflections in a Fractured Mirror.** Pretoria: Van Schaick.
- HOGG, J. 2003. R**hythm Trilogy.** http://www.Vuyani.co.za/ensamble.htm (24/02/03)
- **Housing Development.** 2002. Http://www.jda.org.za/Newtown/Current_projects/DF.htm
- HUMPREYS, H, R. 1979. *Sound Insulation in Buildings.* London.
- JENKS, M and BURGESS, R. 2000. **Compact Cities: Sustainable Urban Forms for Developing Countries.** London: SPON Press.
- JOHANNESBURG CITY COUNCIL. 2001. **Integrated Development Plan: Joburg 2030.** h**ttp://www.Johannesburgnews.co.za (02/02/2003)**
- KAPLAN, M. 2000. **Rebuilding Cato Manor.** Journal of the KZ-N Institute for Architects. Durban, March 2000.
- KIRCHHOFER, M. 1980. **Newtown Redevelopment Report No.2.** Johannesburg: Max Kirchhofer.
- KOTZEN, B and ENGLISH, C. 1999. *Environmental Noise Barriers.* E & *FN SPON Publishers. New York.*
- KROUSE, M. 2003. ZA@Play. **Class Dance.** http://www.chico.mweb.co.za/art/dance.htm (24/02/03)
- LIPMAN, A. 2003. **Art as public property.** Leading Architecture, March/April 2003, p38 - 39.
- LUDMAN, B.2003. **SA cities scoop art awards.** Http://www.safrica.info/arts (23/10/03)

• LUND, T. 2002. **Dance for Life.** Fairlady, **6 November 2002, p64 - 67.**

• MAJAVU, M. 2002. **Metro Mall opens doors to public. http://www.johannesburg.gov.za/index.htm**

• MALETIC, V. 1983. **Dynamics of Phrasing in Movement and Dance.** Biennial Conference: International Council of Kinetography.

•MASONDO. 2002. **City Development Plan, 2002: A Developmental Overview of the City. http://www.joburg.org.za (02/02/2003)**

• **Market Theatre. 2002. http://www.jda.org.za/Newtown/Current_projects/DF.htm (02/02/2003)**

• LUND, T. 2002. **Dance for Life.** Fairlady, **6 November 2002, p64 - 67.**

• **Mary Fitzgerald Square. 2002. Http://www.jda.org.za/Newtown/Current_projects/DF.htm (02/02/2003)**

• McCARTHY, T.S. 1986. **Guidebook to Sites of Geological and Mining Interest on the Central Witwatersrand.** Johannesburg: Geology Society of South Africa.

• McPHEE, C. 1948. **Dance in Bali.** London.

• MITLIN, D and SATTERTHWAITE, D. 1996. **Sustainability, the Environment and Urbanization.** London: Earthscan.

• MORTON, R and JAGGER, D. 1995. *Design and Economics of Buildings.* E *& FN SPON Publishers. Kent.*

• NAPIER, A. 2000. **Enviro-friendly Methods in Small Building Design for South Africa.** Natal: Alaric Napier.

• **Nelson Mandela Bridge.** 2002. Http://www.jda.org.za/Newtown/Current_projects/DF.html (02/02/2003)

• **Neufert Architect's Data,** edited by Jones et al. 2000. London: Blackwell Science.

• NORBERG-SCHULZ,C. 1980. **Genius Loci, Towards a Phenomenology of Architecture.** New York.

• NORBERG-SCHULZ, C. 1969. **Meaning in Architecture.** London.

• PAPADAKIS, A. C. 1992. **Free Space Architecture.** Architectural Design, Vol. 96. New York: St Martin's Press.

• **Potential energy of selected materials. 2002. http://www.CSIR.html (05/03/2002)**

• **Potential energy savings. 2002. http://www.CSIR.html (05/03/2002)**

• RAKODI,C. 1997. **The Urban Challenge in Africa: Growth and Management of its Large Cities.** New York: United Nations University.

• RICHTERS, C. 1999. **Industrial Icon.** Architectural Review, June 1999, p.65 - 69.

• RUSSOUW, S. 2002. Official site of the City of Johannesburg. **Turbine Hall set for a Jol.** Http://www.joburg.org.za/Turbine Hall/index.htm (24/02/03)

• RYAN,R. 1999. **Stage Play.** Architectural Review, Jan - March 1999, p. 54 - 57.

• SABS (Raad van die Suid-Afrikaanse Buro van Standaarde). 1990. **SABS 0400 - Die toepassing van die Nasionale Bouregulasies.** Pretoria: Suid-Afrikaanse Buro vir Standaarde.

• SCHWARTZ, J. 1982. **Tracking, Tracing, Marking, Pacing.** New York: Pratt Institute.

- SCOTT, A. 1998. *Dimensions of Sustainability.* E & FN *SPON Publishers. Hong Kong.*
- SEABROOK, J. 1996. **In the Cities of the South: Scenes from a Developing World.** London: **Verso.**
- South African Weather Services. 2002. **Average climate statistics for Johannesburg.** H**ttp://www.weathersa.co.za/index.html (24/02/03)**
- SPOORMAKER, H, J. 1998. *Occassional Paper on Energy Conservation and Energy Management for Commercial Buildings. University of Pretoria. Pretoria.*
- S T I INSULATION. 2002. *Sol-Thermo Loft: Original. Johannesburg.*
- THALE, T. Official site of the City of Johannesburg. **Metro Mall poised to open for business.** H**ttp://www.johannesburg.gov.za/index.htm (24/02/03)**
- THOMSON, G. 2003. **FNB Dance Umbrella, 2003. http://www.artslink,co.za/fnb/umbrella.htm (24/02/03**)
- VAN RENSBURG, R. 2000. *Gebouklimaat 322 Class Notes: Daylighting. University of Pretoria. Pretoria.*
- VAN ZYL, B, G. 1999. *Acoustics for Architectural Students: Lecture Notes. University of Pretoria. Pretoria.*
- WILMERT. 2000. **The Return of Natural Ventilation.** A**rchitectural Record, August 2000, p 134 145.**
- ZELANSKI, P. And FISHER, M. 1984. **Design: principles and problems,** N**ew York: CBS College Publishing.**