9. TECHNICAL

TECHNICAL INFORMATION

Site Conditions

The site forms part of the top of an existing parking arcade witch runs underneath the rest of the Sammy Marks development for three levels, used for parking and services. For the proposed development the parking entrance and exit on Prinsloo Street will be used. At this basement entrance and exit point the hotel will be stepped back to allow for enough head space for cars and service trucks. This means that the side walk on Prinsloo Street falls from Church Street to Vermeulen Street with about 1,3m and it is on this height that vehicles enter and exit the Basement.

Figure 9 -1 Entrance/ Exit ramp from basement

Figure 9 -2

Parking will be provided in the existing basement underneath The Sammy Marks development and will have to be shared with the hotel functioning separately. There will also be VIP parking as well as coach parking created nearby the hotel's drop off, on the side of Prinsloo Street. Parking on Church Street will be limited as this part of Church Street between Prinsloo and Van der Walt is for pedestrians.

The sewer and water connection is situated on Prinsloo Street next to the basement entrance and exit and is in close proximity to the hotel's service and ducts.

There is an existing column layout/grid running from the third basement level through onto the site, which was designed to support a 23-story development (Murry and Roberts). This column grid will be incorporated into the proposed hotel development as far as possible; this will be further discussed in the structure of the building.

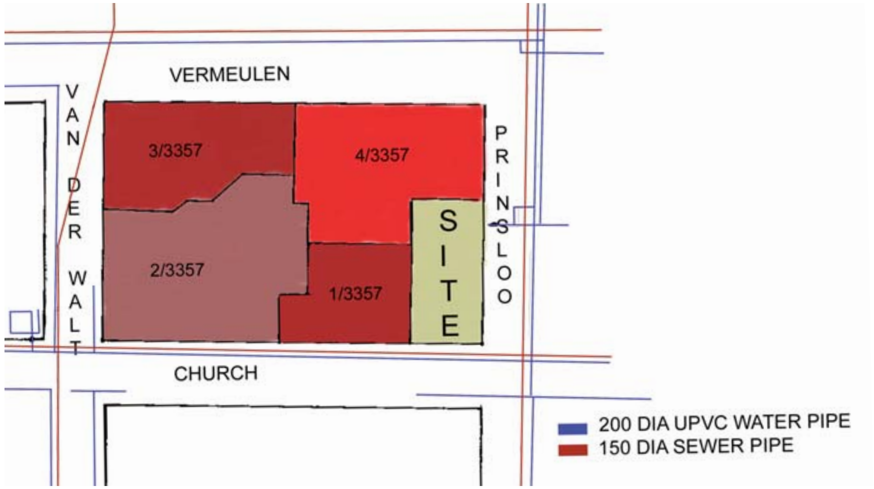
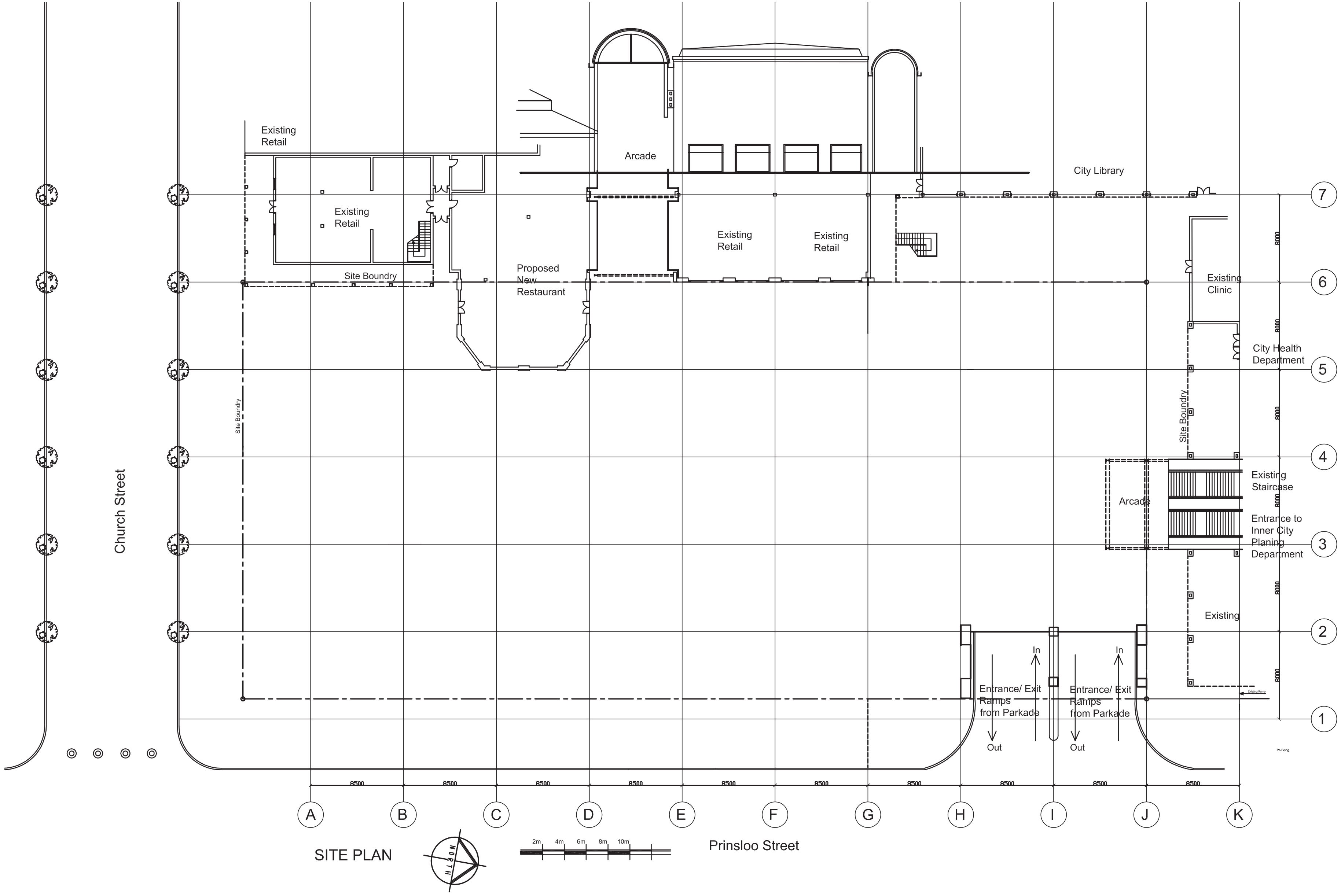


Figure9 -3 Water and Sewer layout around site

Figure 9 -4



SITE PLAN

Existing Retail
Arcade
City Library
Existing Retail
Existing Retail
Existing Retail
Site Boundry
Proposed New Restaurant
Existing Clinic
City Health Department
Site Boundry
Site Boundry
Church Street
Existing Staircase
Arcade
Entrance to Inner City Planing Department
Existing
In
In
Entrance/ Exit Ramps from Parkade
Entrance/ Exit Ramps from Parkade
Out
Out
Parking
7
6
5
4
3
2
1
8000
8000
8000
8000
8000
8000
8500
8500
8500
8500
8500
8500
8500
8500
8500
8500
A
B
C
D
E
F
G
H
I
J
K
NORTH
2m
4m
6m
8m
10m
Prinsloo Street

SUPERSTRUCTURE

The structure of the building consists of a reinforced concrete frame clad with brickwork. It has two main components, a tower block and a much smaller retail block. The two blocks are connected by a bridge on the second floor and the bridge deck hangs from beams at roof level.

There are three existing basements under the tower block and they extend some distance under the retail block as well. The existing building (the three basements) was originally designed for another 23-story to be added and the proposed hotel is within this limit. The existing columns are mostly 800x800 with a few 1700x900. Reinforcing bars to the columns have been left sticking out to lap with rebar's for the new development. Above 1st floor, 800x800 columns are hollow in the middle to house services, which are taken into the ceiling void at the lower level. The walls of the lift shafts and the stair case are concrete to help with the overall stability of the building.

The floor grid is 8,5m x 8m to match the existing and the floors are 340 thick through slabs, with suspended ceilings. Concrete strength for columns is 40 Mpa after 28 days for slab and beams 30 Mpa for lift and stairwell walls 25Mpa.

Due to the existing basement it is difficult to sensibly introduce an expansion joint between the tower block and the retail block and because of this it was decided to design it as one building.

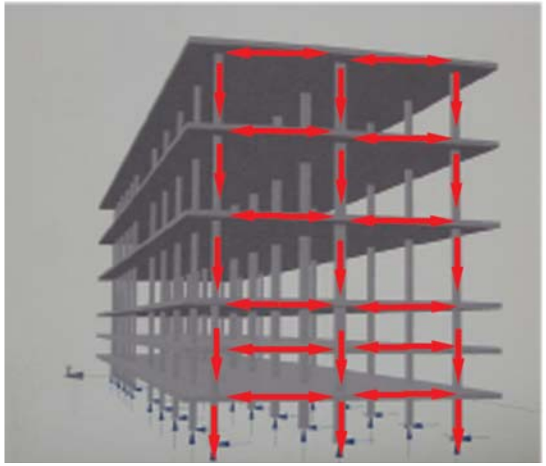


Figure 9 -5
Retail block, column & slab layout
Showing distribution of loads

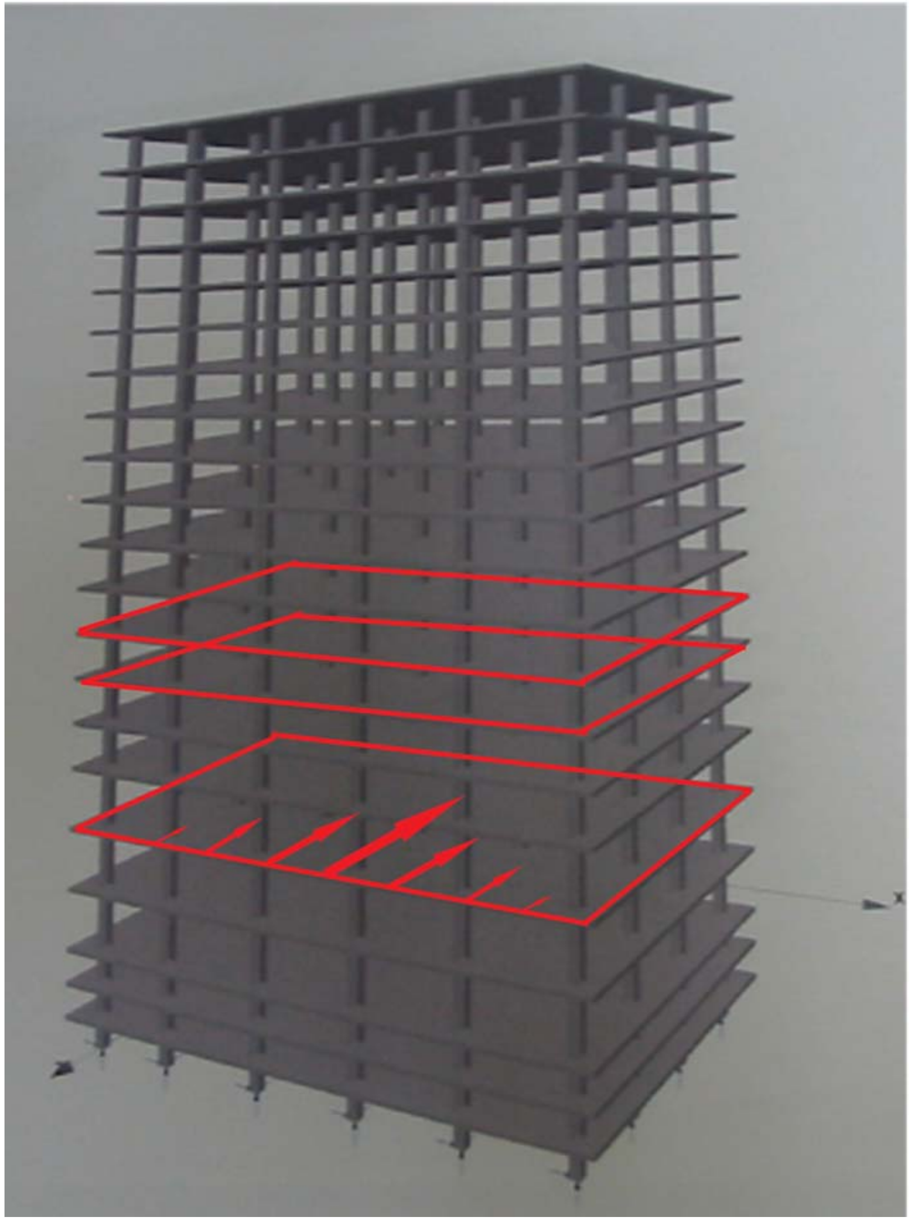


Figure 9 -6

Model of Tower block indicating slabs acting as deep horizontal beams, transferring horizontal(wind) forces to columns.

Prinsloo Street

🟥 **Existing columns from Basement levels**

BASEMENT -MEZZANINE FLOOR PLAN

MATERIALS

All actions and elements used in the built environment consist of energy. As energy is a capital cost, it is important to have a proper understanding of the various energies so that it may be used more efficiently. This is also a requirement for the realisation of the national energy conservation goals and is closely connected to the whole issue of sustainability, which now, more and more, becomes a design requirement for all developments.

“Approximately 40% of the annual resources expenditure is consumed by the construction industry. The criteria for selecting materials, to date, have firstly been for structural stability and thereafter largely for aesthetic and first monetarily cost. Durability or life cycles monetary cost is only considered in some institutional and high-end commercial projects. Architects must weigh up a number of issues when considering measures to minimize embodied energy use. The first call must be to select the type of materials that, in their manufacture, use little energy. These are either materials that can be used close to their raw state, such as stone, timber and compacted earth, or recycled manufactured materials such as crushed brick and concrete, hard core and reused steel joists, waste materials from other processes. All of these elements can be assigned a resource value, a result that will make the selection process much less a matter of guess work on the part of the specifier.” (St. John, 1992).

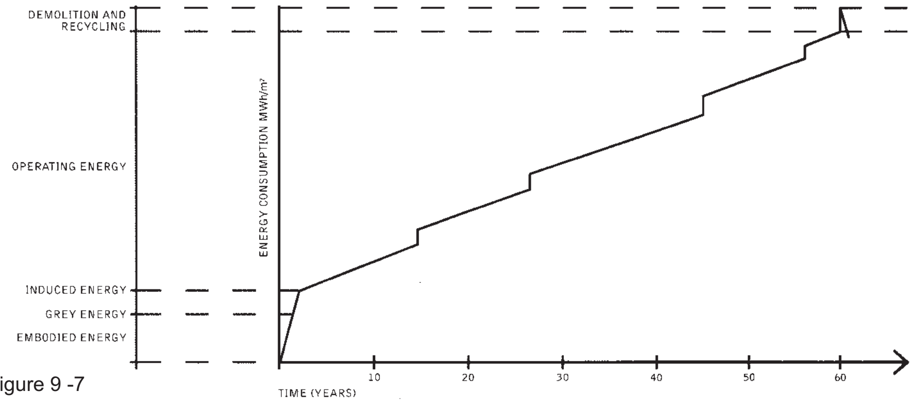


Figure 9 -7
ENERGY CONSUMPTION IN BUILDINGS (JONES, 1998).

“There are two basic aspects to the issue of energy in building design: how it can be used efficiently, and what form it should take. Energy conservation is as much about choosing the appropriate time, as it is about saving that energy. As regards the construction and occupation of buildings, parameters relating to the use of energy will vary according to location and political and economical factors. A building consumes energy in a number of ways: in the manufacture of building materials, components and systems (embodied energy); in the distribution and transportation of building materials and components to the constructions site (grey energy); in the construction of a building (induced energy); and in running the building and its occupants, equipment and appliances (operating energy). A building also consumes energy in its alterations and final disposal (embodied energy).” (Jones, 1998).

An energy efficient building looks to reduce consumption in all of these areas. The total energy budget of a building with state of the art, energy conserving technology has been significantly reduced over the last 20 years. Almost all of that improvement has come in the form of operating improvements and now the proportion of the energy budget devoted to operation has been reduced from approximately 75% to about 50% .

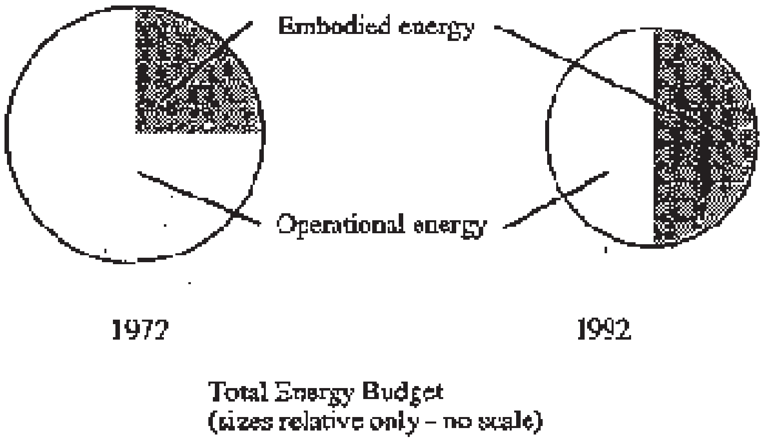


Figure 9 -8
TOTAL ENERGY BUDGET (ST. JOHN, 1992).

"The material cycle is a strong three way inter action among recourses, environment and energy. As we proceed around the material cycle we see energy inputs required to obtain metals from ores; to make plastics from crude oil; to work and shape metals, ceramics and plastics; to assemble components and systems; to transport goods at all stages of production and to operate the final product in the hands of the consumer. Then we see energy dissipated as metals corrode or rust, as plastics degrade and as the trash in the sanitary landfill returns to the low energy natural stage. The production of goods requires more energy when natural recourses rather than recycled materials are used. Recycling therefore must be considered of primarily importance not only for materials and environment consideration but also for energy conservation.

The nature and volume of materials actually required by industry depend not only on the demand for goods and services, but also equally on the characteristics of the technologies used to transform resources into products. The nature and "resource productivity" of a specific sequence, and the quantitave balance between them, dictates the structure and geographical distribution of industrial activities and the nature, quantity and geographical origin of resources required for the making of products. The nature of materials used by industry is not only important in determining the demand for the natural resources from which they are derived. Indirectly they, and the processes used in their conversion, also determine the demand for other resources. From the point of view of resource consumption, it is also significant that large amounts of waste are generated in many of the processing stages of traditional manufacture. This wastefulness, found in much in our traditional manufacturing technologies, places basic physical constraints on the productivity, theoretically attainable at both the national and industrial level. Any improvement in technology from this point of view would lead to a large savings in the use of recourses." (Gabor, 1978).

MATERIAL AND RECOMMENDATIONS

CONCRETE

"Although concrete consists mainly of natural occurring materials that have been in the use since the time of the Romans, its modern use involves energy intensive processes, particularly in the manufacturing of cement and aggregates and transport for manufacture, transportation and installation. A problematic environmental issue is the wasteful use of wood as a disposable forming material. The disposal of demolished concrete is also a problem, and recycling takes a significant added amount of energy, ending with a lower quantity product.

In specifying concrete the following should be considered:
- Is concrete the most appropriate material? Is the structure been planned as a long life structure?
- Use repetitive shapes so that formwork can be reused.
- Avoid extensive use of concrete as a finished material, both to minimize the use of forming lumber and to cut down on embodied energy.
- Avoid using aggregates or cement types not normally used or stocked in the project's region. Specify locally mined and produced materials when ever possible.
- Specify only non-toxic concrete additions." (St. John, 1992).

MASONRY

"Historically bricks were produced from local clay, and sun dried or fired in kilns with local fuel, thus reducing transport energy cost. Although masonry's embodied energy is high, when all of its thermal barrier and storage, structural and finish properties are realized in one application it winds up being relatively resource effective.

In specifying masonry the following should be considered:
- Be sure the application is an appropriate one for the use of masonry, and that two or three of its positive qualities will be utilized.
- Be careful of the use of chemical treatments for mortar, inform yourself about their environmental effects.
- Look for the most efficient method of insulating exterior walls, using as high levels of insulation as practicable.
- Consider the use of masonry made with recycled and waste materials." (St. John, 1992).

WOODS

"The cultural and emotional place it holds in our collective conscious is evident in every part of the globe. Wood is one of the oldest and most versatile of building materials, and continues to play a major part in almost every building project. Properly managed as a renewable resource, it should continue to be a basic construction material indefinitely.

In specifying masonry the following should be considered:
- Find alternatives to old grown timber for all wood uses.
- Use wood whose origins are known to be sustainable or that of which are well managed.
- If a client demands the use of rare woods, use veneers instead of solid wood.

Veneers provide more effective use of the whole tree, and substrate can be made from sawmill scrap or waste." (St John, 1992).

PLASTICS

"Plastics are substrates composed of a mixture of organic materials. Plastics can be created from any biomass, but at this time they are mostly made from oil, natural gas, coal and salt. The key to use plastics, even more important than with some other materials, is to correctly match the material to the use.
In specifying plastics the following should be considered:
- Remember most plastics are petroleum based – explore alternatives.
- Use easily recycled plastics- avoid composites difficult to recycle.
- Avoid plastics for coating, bonding and sealing.
- Recycle, recycle and recycle." (St. John, 1992).

This clearly indicates that not enough prominence is given to the matter of sustainable design and the use and conservation of embodied energy. Professions of the built environment can play an important role to ameliorate this problem in the near future. In the end, selection of materials and systems for anyone building project, should be the result of a balanced analysis of the required performance of the building against assessment of embodied energy in the manufacture and processing of material components; an assessment of embodied energy consumption, covering identification of the original source of the materials and the energy costs involved in transporting the materials and components to the site; and what can be done in the field of limiting recycling and using waste materials.

ROOFS

Waterproofing membranes and roof repellent layers must be applied to the roof, together with adequate drainage, landscaping cloth, irrigation systems and other specialised products. But after this the environmental benefits are considerable, including a reduction in the "greenhouse effect"; cost savings from increased storm water retention with a reduction in the expansion of the related infrastructure; a decreased need for health care services from reductions in ground level ozone resulting from the reduction of urban heat; increased work productivity and creativity; and the incalculable benefits of passive experiences with nature and vegetation.

A green roof will have a noticeable impact on the heat gain and loss of a building, as well as the humidity, air quality and reflected heat in the surrounding neighbourhood. On a summer day the temperature of gravel roofs can increased by as much as 25°C to over 80°C or more in some cases. Covered with grass, the temperature of that roof would be contained around 25°C – with the resultant energy savings.

In real terms, 20 cm of substrate with a 20-40cm layer of thick grass has the combined insulation value of 15cm of mineral wool, and rooms under a green roof are at least 3-4°C cooler than the outside air when temperature ranges between 25-30°C.
Soil, plants and the trapped layer of air can also be used insulate sound. Sound waves that are produced by machinery and traffic can be absorbed, reflected or deflected, with the substrate tending to block the lower sound frequencies and the plants the higher. A green roof with a substrate of 20cm can reduce sound by 40Db. (Walls and roofs, 2003)

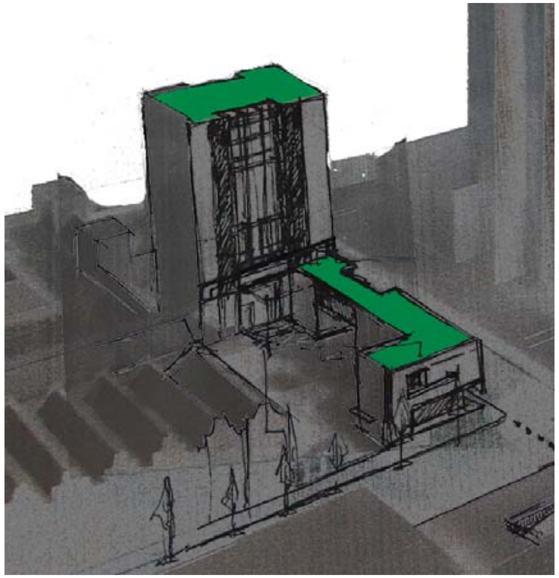


Figure 9 -9 Concept sketch showing green roofs

VERTICAL SERVICES

The general circulation layout is all about facilitating movement and to provide for the separation of guest, staff and maintenance personnel. This is not just to avoid disturbing the guests, but also to enable efficient servicing. Separating the circulation of resident and non-resident guests was very important and was achieved by providing direct access to the restaurant and ballroom from the main kitchen situated on the first basement level, which in turn have their own service kitchens.

The vertical communications in a multi-storey building are essential to its operation and are an important element in the planning. The elevator shafts extend the full height, and their location dictates the main circulation of people on each level. The elevators and stairs form a substantial vertical element, which is used for structural purposes. Toilets and utility rooms, air ducts, plumbing and electrical ducts are incorporated into the core so that the remainder of the floor plan is free from vertical ducts.

BASEMENT -MEZZANINE FLOOR PLAN

“Ducts are avenues through which sound can travel readily from central equipment to rooms, and between rooms. Air noise that might be transmitted through the duct system is reduced with sound- absorbent inner linings, plenums lined with absorbent material, or premanufactured sound traps designed for insertion in the ducts. All service pipes will be firmly attached to heavy walls, which will minimize transmissions of noise to rooms. Some electrical equipment produces a hum that can be annoying under some circumstances. Large transformers in this case are placed in the 3rd basement level as far away from quite areas as possible.” (Bradshaw.V.1993)

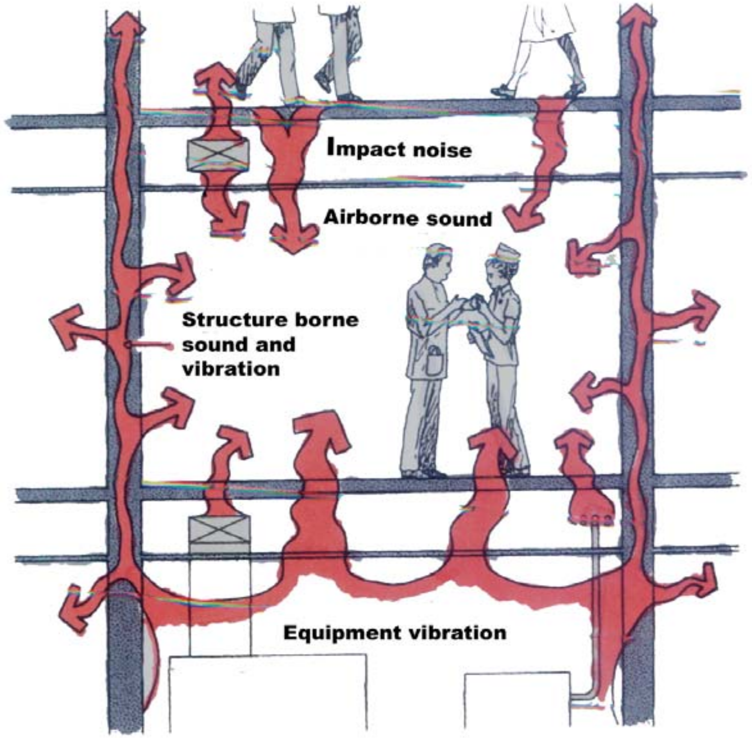


Figure 9 -10 Transmission of noise through building elements

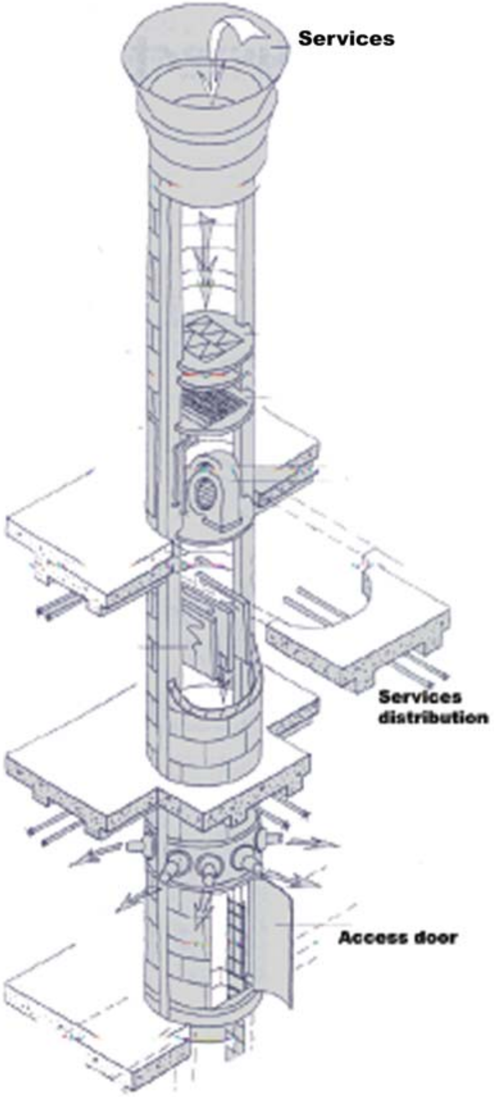
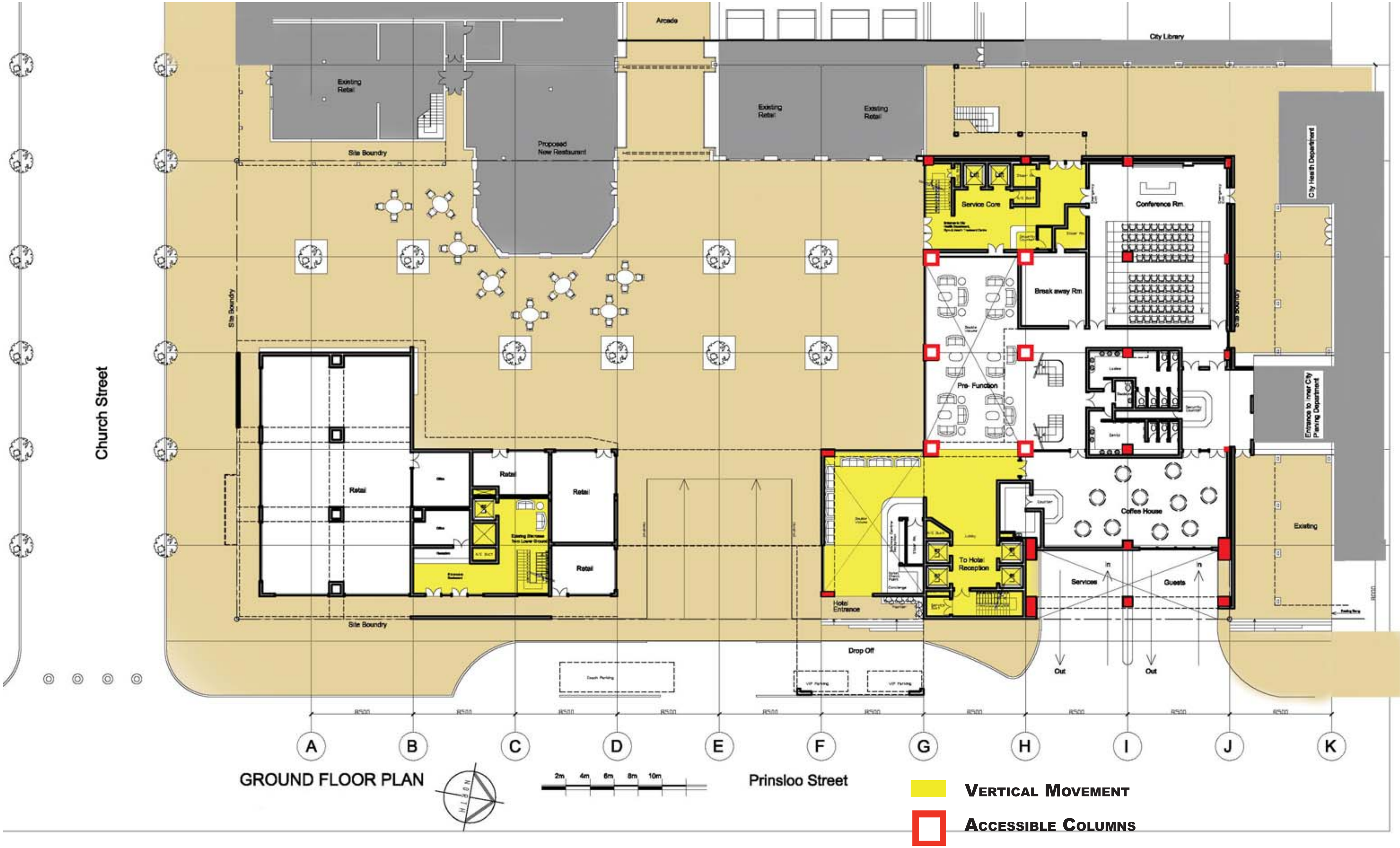


Figure 9 -11 Schematic diagram of hollow columns



GROUND FLOOR PLAN

Hotel Rooms

Bedrooms

“Bedrooms are the core of the hotel industry. For flexibility most rooms have a double bed or twin beds. Bedrooms normally have en-suite bathrooms. It may be assumed in preliminary calculations that the capital cost of a room will approximate to 1000 times its nightly rate.” (Adler, 2005)

Corridor widths and bedroom sizes are greater in more expensive hotels. In the proposed hotel the corridors are 1.6 metres with a small lobby before entering the rooms with bedroom sizes of 36m2 (acc. to five star regulations).

To avoid an institutional appearance corridors should not appear too long. Fire regulations determine the positioning of escape stairs. This was one of the main reasons why the internal bathroom layout was chosen for the hotel bedroom floors. It helps significantly with sound insulation from corridor noise. The bathrooms will require artificial lightning and ventilation, but the external walling and the corridor length are minimised.

The ratio of single rooms to double rooms will be decided by the client depending on expected use. In this case it is for business executives and will require many single rooms. This is also the reason not to include balconies, but instead to use the space as working areas inside the rooms. It also minimizes the problems of security, wind and waterproofing. A raised threshold is always needed, and guests may slip or trip, causing claims for damages.

Planning problems at corners of the tower block was eased by having suites with a common lobby in these areas of the block. Five percent of rooms will be suitable for wheelchair users. This includes providing a much larger bathroom for wheelchair accessibility.

Air Conditioning

The air – conditioning system best suited to for this project is a central chilled water system. This system allows for an unlimited number of chilled water coil units that is operated separately but feed of the same chilled water supply. Chilled water is processed centrally in the chiller plant room in the basement. From here it is distributed in a close circuit to the various chilled water coil units. The cooling towers for cooling of the chilled water is located on the roofs of the building. The chilled water coil units vary in size from smaller console units for each guest room to bigger units for the public floors that are accommodated in the respective air-handling units for each floor. Each of these chilled water coil units then has it’s own fresh air supply and ducting for exhaust and return air. Each guest room has it’s own chilled water coil unit located in the ceiling void. This unit releases air into the room that is a mixture of fresh and return air. An air-handling unit on the roof of the building supplies fresh air. Exhaust air is simply disposed of individually at the top of each duct. The three floors containing the restaurants as well as the basements levels each have their own air-handling unit. (V d Westuizen, M. C, 1998)

The type of glass used for the fenestration of the building and its construction is of such a nature that would deliver the best possible thermal efficiency. The tower block is facing a north- south orientation that will help limit the big demand the air- conditioning places on the buildings resources.

“An electrical driven water chiller uses the same vapour compression refrigeration cycle as a DX (direct expansion) system. It has five connecting points for inputs and out puts:

- Electricity input to operate the compressor
- Chilled water return from the space- cooling equipment
- Chilled water supply to the space- cooling equipment
- Condenser water supply from the outdoor heat rejecting equipment
- Condenser water return to the outdoor heat rejecting equipment

A water chiller is a factory- designed, prefabricated assembly containing one or more compressors, condenser, water cooler and interconnections.

There should always be a floor drain located near a water-cooled condenser in case of leaks and of convenient disposal of water when the system is drained for repair. There should also be sufficient space around the chillers for insulations and maintenance personnel to work without restrictions.” (Bradshaw. V.1993)

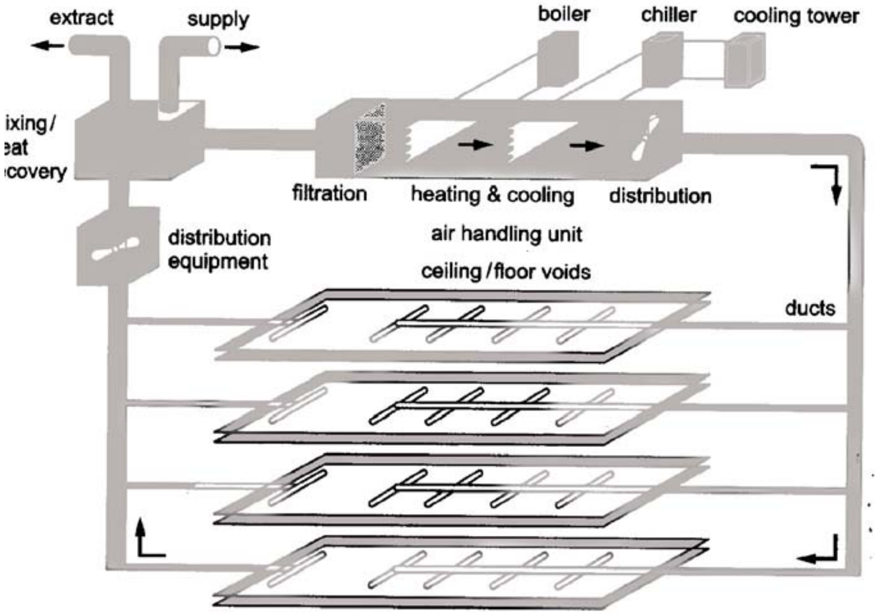


Figure 9 -12 Air- conditioning layout diagram

FIRE

“Tall buildings and those extending over large areas have portions that cannot be reached by ladders and hoses. Large buildings therefore require their own fire- fighting systems. The most common means of fire suppression is the use of water supplied by automatic sprinkler systems or standpipe systems. There is provision made for fire brigade vehicles and appliances, and provisions for firemen’s lifts. Special water storage tanks and fixed fire mains and hydrants will be provided in and around the hotel. If the effects of a fire are to be minimized and occupants allowed an opportunity to evacuate, fires must be contained within their immediate area of origin. Walls and partitions with fire resistance ratings should be provided in order to prevent the spread of fire from developing. The more compartments within an area, the better the chances for effecting fire control, minimizing damage, and preventing the fire from spreading and destroying other parts of the building.”(Bradshaw.V. 1993)

The building’s normal HVAC system is frequently used for smoke control. It is arranged so that it can either pressurize a zone or evacuate smoke from it as needed. The basic principal of zone smoke control is to provide a positive air pressure in the areas of safe refuge and a negative pressure in the areas of smoke contamination. The proposed hotel development has a number of smoke control zones, each separated from the others by partitions, floors, and doors that can be closed to inhibit the smoke movement.

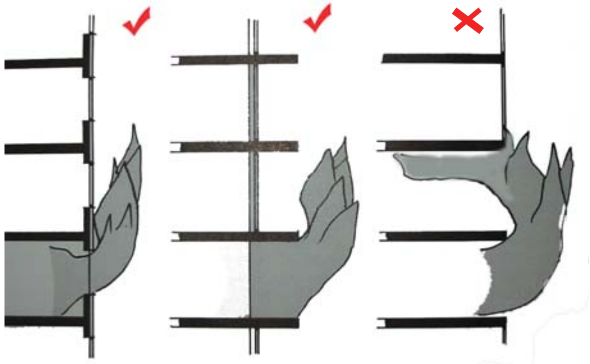
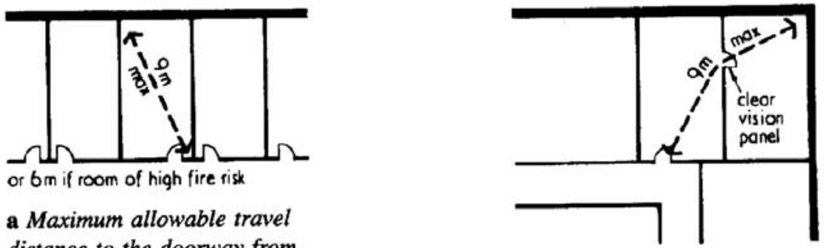
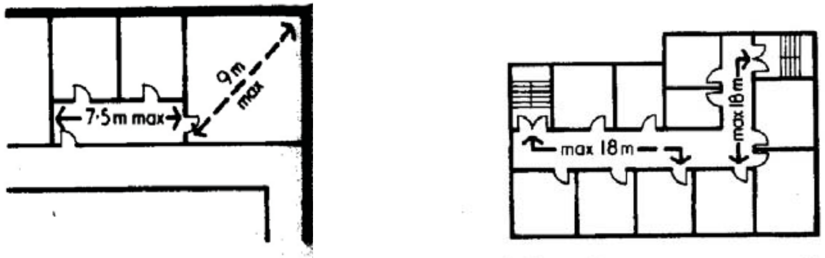


Figure 9 -13 Diagram showing the correct way of preventing spread of fire’s trough the use of the building structures



a *Maximum allowable travel distance to the doorway from the most remote corner of the room.*

b *In multi-room suites no single cross-room dimension should exceed 9 m.*



c *In multi-room suites any associated private corridor limited to 7.5 m long.*

d *Stage 2 escape; no room exit further than 18 m from entrance to protected escape route.*

Figure 9 -14 Diagram a- d showing fire regulations within a large building