Proceedings of Symposium on Mosque Architecture, Vol. 6B, pp 43-62,College of Architecture & Planning, King Saud University (1419H-1999)

The Environmental Control: An Outlook on Mosque Design on Selected Examples in Durban, Kwazulu-Natal, South Africa

Barbara Jekot

School of Architecture, University of Natal
Durban, South Africa

Abstract: In summer all humans suffer in Durban from the subtropical climate - especially the humidity. Continuos and efficient ventilation is the primary comfort requirement. Protection from sun, rain and insects as well as prevention of internal temperature elevation during the day should effect all aspects of building design. The Grey Street Mosque and the University of Natal Mosque are presented to illustrate two different approaches and proved the conclusion of the paper. Mosque architecture following the Islamic tradition should lead to an understanding and meaning of environmental control. The planning and design criteria of mosque architecture should integrate a broad range application of ventilation, solar, acoustic and visual control. With the continued application of these concerns mosque architecture will continue to be in a better position to declare itself as an important force against environmental hazards. Mosque architecture embraces fourteen centuries of tradition, which has been explored in many different regions all over the world.

Introduction

"Historically the mosque was of such central importance to
The life of the community that it became the dominant building and this form is echoed in structures built for other purposes. [5, p.539]

The architecture of Mosque is not restricted to building. It is the exclusive development of a space and environment. The best of the natural world is combined with the man-made. This is the core for Mosque design.

Mosque spaces and volumes represent the body in which ventilation and air-cooling system as well as solar and acoustics control played the distinguish role. Parts of Mosques are arranged around a courtyard and very close together and thereby shade each other from the harsh sun. The thick walls reduce daytime radiation and night radiation. Windows are closed to trap warm air, but excess air goes out via the wind towers.

Water in Islam symbolizes the descent of revelation. In ablution through water the Muslim is reintegrated symbolically into is primordial state. Water plays a vital role in attracting forms of life as well as people around. Water is like a magnet, which polarize space. Water

is molded and spread out. Water is used to humidify the air and making temperatures bearable.

Wind is brought through catches and forced downwards to the water to increase the humidity level to an acceptable percentage. Wind coming from catches/towers and perforated domes carry less sand. High structures provide shade for surrounding buildings.

Different treatments of windows and screen patterns enhance the character of the architecture and create shadows. All openings are protected. Screens filter light but still allow wind to go through and protect against sandstorms. Winds pass through screens dropping the sand, filtering the light. Applied materials are not affected by climate.

Screens create characteristic illumination bringing very special atmosphere.

Porches, arches and niches influence by plants and cosmos represent connection, Transformation and culmination. They transform space between the temporal and the terrestrial world. Verandas shade the harsh sun.

Standardization of Mosque elements of ventilation, solar and acoustic control is discussed.

Durban Climatic Context and Requisitions

In summer all humans suffer in Durban from the subtropical climate - especially the humidity. Continuous and efficient ventilation is the primary comfort requirement. Protection from sun, rain and insects as well as prevention of internal temperature elevation during the day should effect all aspects of building design. [7, p.352]

The layout of the surroundings, planning as well as the size and location of windows are crucial. Open planning and shadow free spaces between buildings help to achieve good ventilation. Openings should be positioned on both windward and leeward sides of the buildings to facilitate cross ventilation. Large openings should be protected from sun penetration and rain. They should be open during the night therefore security is required. There are demanding requisitions.

Immigrant's Environmental Response

In Durban, KwaZulu-Natal, South Africa architecture is of diverse cultural origins. Its diversity is displayed in countries of origin of immigrants mainly from Europe and Asia.

Mostly British immigrants who arrived in the first half of the nineteenth century represented the Europeans. Natal become the most English of the states and colonies in Southern Africa.[10, p.XI] European influences were dominated by Victorian styles and the major contribution was the development of the free standing veranda-house. Concern for the environment was crucial.

Later on the domination of Victorian architecture was enriched by influence of Islamic architecture. Muslims began to arrive to Durban, Natal, South Africa in the nineteen century although the first Muslims arrived in South Africa in the seventeen-century. In 1667 Malayan slaves were introduced to the Cape. [8, p.5] They originated from five regions. The coastlands of India and Ceylon; the Malaysian-Indonesian Archipelago; Madagascar and the coastland of Africa were the ancestors of the Cape Muslim community. [13, p.130]

The slaves and their descendants became the builders, bricklayers and masons. Cape Muslims construction of mosques did not immediately emerge. The first mosque was started in warehouse. [3, p.17] Muslims prayed and worked towards development of their identity in

this region of the world. Later in the nineteenth century they were the dominant artisan class. Their design features based on a mixture of Victorian, Georgian and Cape Dutch architecture. The Muslims created a specific aesthetic and influenced the architecture of the Cape. South African mosques have been varied, for instance, "the white-plastered Cape Dutch mosques of the Bo-Kaap, Gothic revival architecture of the nineteenth century mosque, Transvaal verandahed mosques and even wood and iron mosques". [4 p.16]

The Cape climate was not so demanding as the Arabian Peninsula but the Durban climate was (Fig. 1). Islam has 300 years in South Africa [3, p.17] but the Natal Muslims derived from India only in the last century. B. T. Kearney puts it in 1860, [10, p.37] but S.Dangor circa 1871. [1, p.2] They brought memories of the Moguls in India and their building style. [9, p.9]

Mosque types are predetermined and have received as many stylistic expressions as the cultures and region of the converts to the religion. Mosques in Durban have represented not only the stylistic expressions of Islamic architecture. The importance of regional and climatic responses are interesting and it is worth while to study their environmental approaches but it necessary to evaluate firstly the mosque architecture environmental approach.

Approach To Mosque Design

The architecture of Mosque is not restricted to building. It is the exclusive development of a space and environment. The best of the natural world is combined with the man-made. This is the core of Mosque design.

Muslim architecture originated on the Arabian Peninsula. The vernacular shelters were sophisticated responses to climatic extremes [9, p.9]

Mosques have been inspired architecturally by Prophet (Fig. 2). Later improvements resulted in mosques comprising the following features:

- A spacious *courtyard* containing a *tank* or *fountain* for ablution,
- A niche -*mihrab* - in a wall oriented to Makkah -*qibla*,
- A pulpit -*minbar* - to the right of the mihrab,
- A screened enclosure protecting the prayer-leader,
- One or more *minarets* for the call to prayer, working as a landmark,

From the seventh to eleventh century mosques had courtyards enclosed by flat-roofed porticoes to give protection from the sun, the deep one fronting the qibla wall forming a domed or multi-domed sanctuary. With the twelfth century came the emerged of a collegiate mosque - the madrasa - in which porticoes were replaced by vaulted architectural spaces - iwans - whose facade usually openings towards the courtyard.

The above mentioned architectural features of mosques like courtyards, porticoes, niches, iwans, towers, etc. have been used to accommodate complex functions as well as create user a friendly environment to enable many different activities during different times of the day. Standardization of ventilation, solar and acoustic control has played an important role in mosques development. Concern for the environment is one of the most important lessons of traditional Islamic architecture integrated with the need for the mosque architecture to suit the activities.

Environmental Elements of Mosque Architecture

Mosque spaces and volumes represent the body in which ventilation and air-cooling system as well as solar and acoustics control played distinguished roles. Parts of mosques are arranged around a courtyard and very close together and thereby shade each other from the harsh sun. The thick walls reduce daytime radiation and night reradiation. Windows are minimized to trap warm air, but excess air goes out via the wind towers.

In the five times daily ablution through waters the Muslim is reintegrated symbolically into primordial state. Water purifies bodies out of dirt and the soul of sin. Water plays a vital role in attracting forms of life as well as people around. Water is like a magnet, which polarises space. Water is moulded and spread out. Water is used to make temperature bearable especially in dry climate.

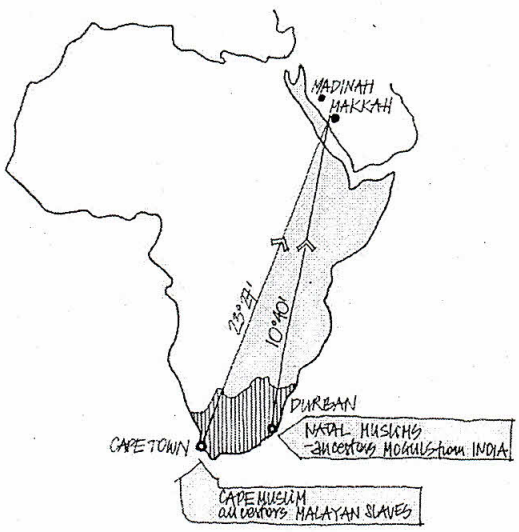


Fig. 1: Islamic architecture in the Cape has more than 300 years tradition, Islamic Architecture in Durban has more than 125 years tradition but their origins are different as well as their environments.

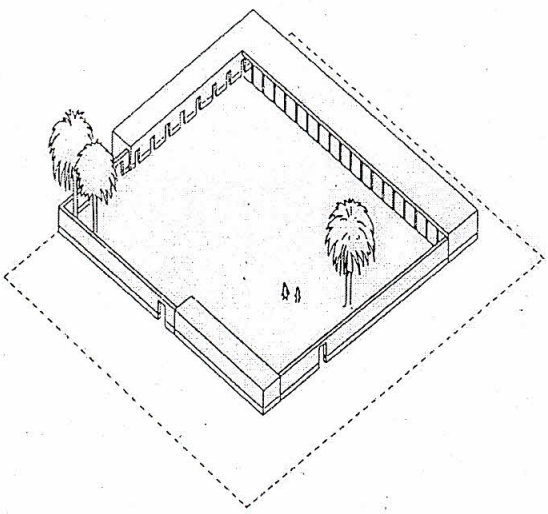


Fig. 2: Mohammed's house become mosque at Madinah. (Source: Kuban/1974:2)

Wind is brought through catches and forced downwards to the water to cool the temperature by evaporation. Wind coming form catches and towers and perforated domes carries less sand. High structures provide shade for surrounding buildings.

Porches, arches and niches symbolically shaped to represent plants and the cosmos represent connection, transformation and culmination. They transform space between the temporal and the terrestrial world. Verandas shade the harsh sun.

Different treatments of windows and screen patterns enhance the character of the architecture and create shadows. All openings are protected. Screens filter light but still allow wind to go through whilst protecting against sandstorms. Winds pass through screens dropping the sand, filtering the light. Applied materials like glazed ceramics and stone are not affected by climate. Screens create characteristic illumination bringing a very special atmosphere. Additionally they provide privacy (visual and access control) and security.

Two Durban Mosques and Two Environmental Approaches

according to Harber to accommodate 200 mats. Neither gives a source for this contradictory information. Near by the Grey Street Mosque was the Indian Market and many additions were added later on. (Figs. 3 - 6).



Fig. 3: The Grey Street Mosque (Jumma Masjid) and the Indian Market at the beginning of this century.



Fig. 4: The Grey Street Mosque (Jumma Masjid) showing a buffer of shops on the street side creating privacy and quiet during the prayer, May 1988. (Photo by B.Jekot).

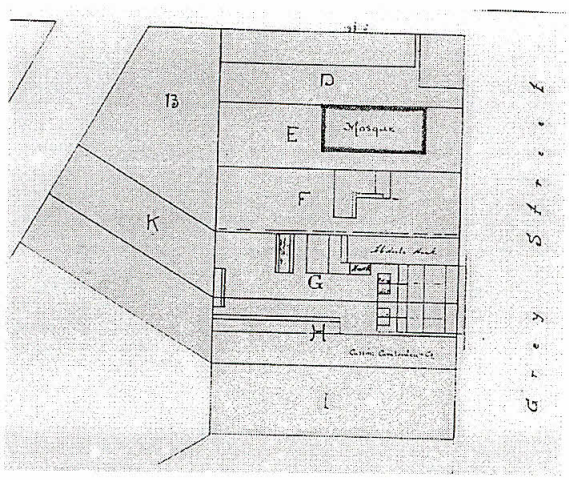


Fig. 5: The Grey Street Mosque (Jumma Masjid) site plan as submitted for approval in 1987.

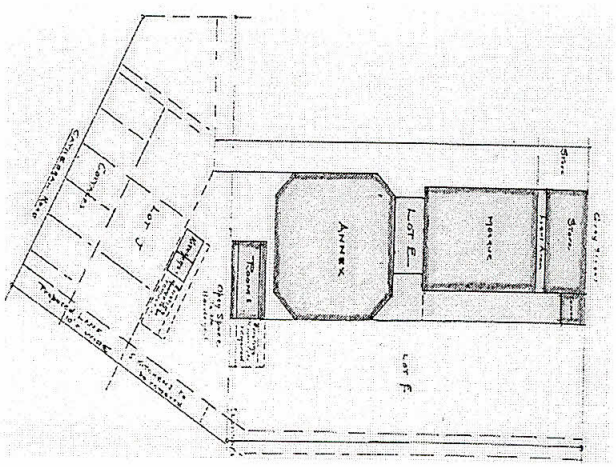


Fig. 6: Proposed to the Grey Street Mosque (Jumma Masjid) for the Madressa Trustees, sections submitted for approval in 1904.

In 1903 a Wuzukhana or ablution gazebo made of Victorian bandstand cast iron components (Fig. 9) was added and the water elements got due form.

A proposed covered way to the Grey Street Mosque for Madressa Trustees (Fig.10) in addition to environmental control - weather protection - represented Islamic symbolism and aesthetics, bringing an oriental character to Durban. Later the Existing Mosque and New Mosque were combined by a covered link, which provided weather control and protection (Fig.11).

In 1897 additions to the Grey Street Mosque by Cassim Camrooden & Co. (Figs. 7 & 8) paid attention to environmental control - especially ventilation. These additions showed characteristics of the veranda-house.

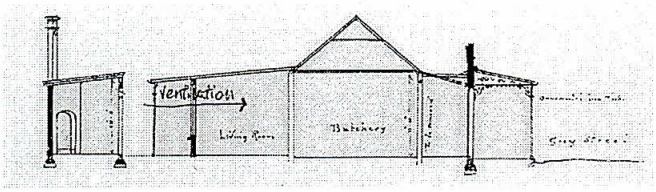


Fig. 7: Section Proposed additions to the Grey Street Mosque (Juma Masjid) by Cassim Camrooden & Co. in 1897. Drawings prove attention given to environmental control.
(Source: Barrie Biemann Architectural Library, Durban, South Africa).

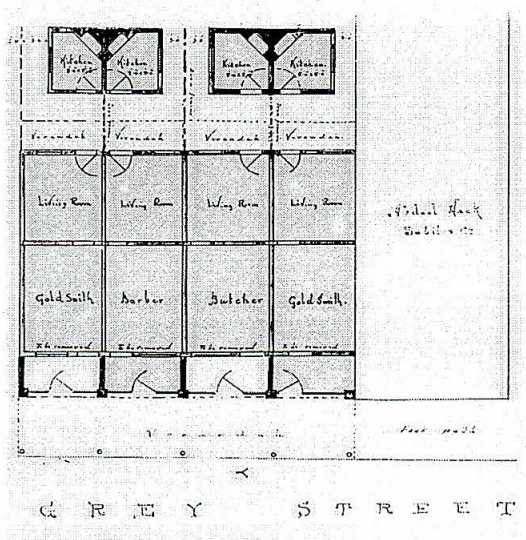


Fig. 8: Proposed additions to the Grey Street Mosque (Juma Masjid) by Cassim Camrooden & Co. in 1897. Drawings prove attention given to environmental control. Drawings prove attention given to environmental control and the plan illustrates influences of the Victorian Verandahouse.
(Source: Barrie Biemann Architectural Library, Durban, South Africa).

that the religious function has been dominated by the commercial periphery and adds that the street is crowded with noisy traffic. [8, p.6] Gafoor makes the point that shops and residential accommodation on the street side created a buffer for privacy and quiet during prayer. Attention was given to ventilation, sun control and acoustic screening when the shops were designed.

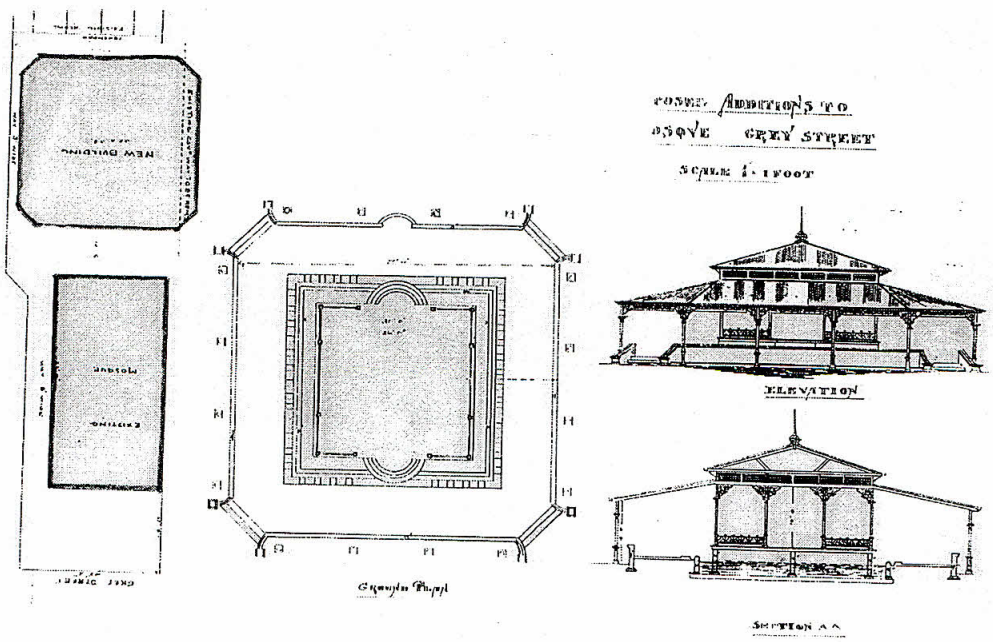


Fig. 9: Proposed a new addition to the Grey Street Mosque (Jumma Masjid). Wuzukhana or ablution Chamber in Victorian cast iron as submitted for approval in 1903.
(Source: Barrie Biermann Architectural Library, Durban, South Africa).

In 1941 the present Grey Street Mosque (Juma Masjid) was designed by architect William Barboure (Figs. 17 and 18) and completed later in 1943.

In the 1980s the courtyard was lost. Natural cooling was therefore insufficient and fans have been installed. Something has been lost something achieved. Noise levels study for the Grey Street Mosque for the peak level on Saturday morning (Fig.21) shows that the optimum area for praying is positioned in the quietest place. The Mosque in the middle of noisy centre works very well. Environmental control of the mosque made the noise and climate bearable.

Today the Grey Street Mosque accommodates over two thousand worshippers on three levels including the roof. It is the largest mosque in the Southern Hemisphere. [8, p.6]

The University Of Natal Mosque - Jama 'At Khanah

The University of Natal Mosque (Jama'at Khanah) was designed by Architects Collaborative cc (arch. Yusuf Patel) in 1994 (Figs. 22 & 23). It is an embodiment of a social institution of a growing Muslim community at the University of Natal. The mosque is located in a wide, open parking lot on campus. This building combines the tradition and contemporary world and synthesises the old and new architectural approaches. The building is mainly experienced internally, a series of transition from exterior to different interiors. It's interiors created an environment for spiritual life. Care was taken to achieve good ventilation in a free standing building not having any courtyard and lack of cool air storage. It was easy to compensate this.

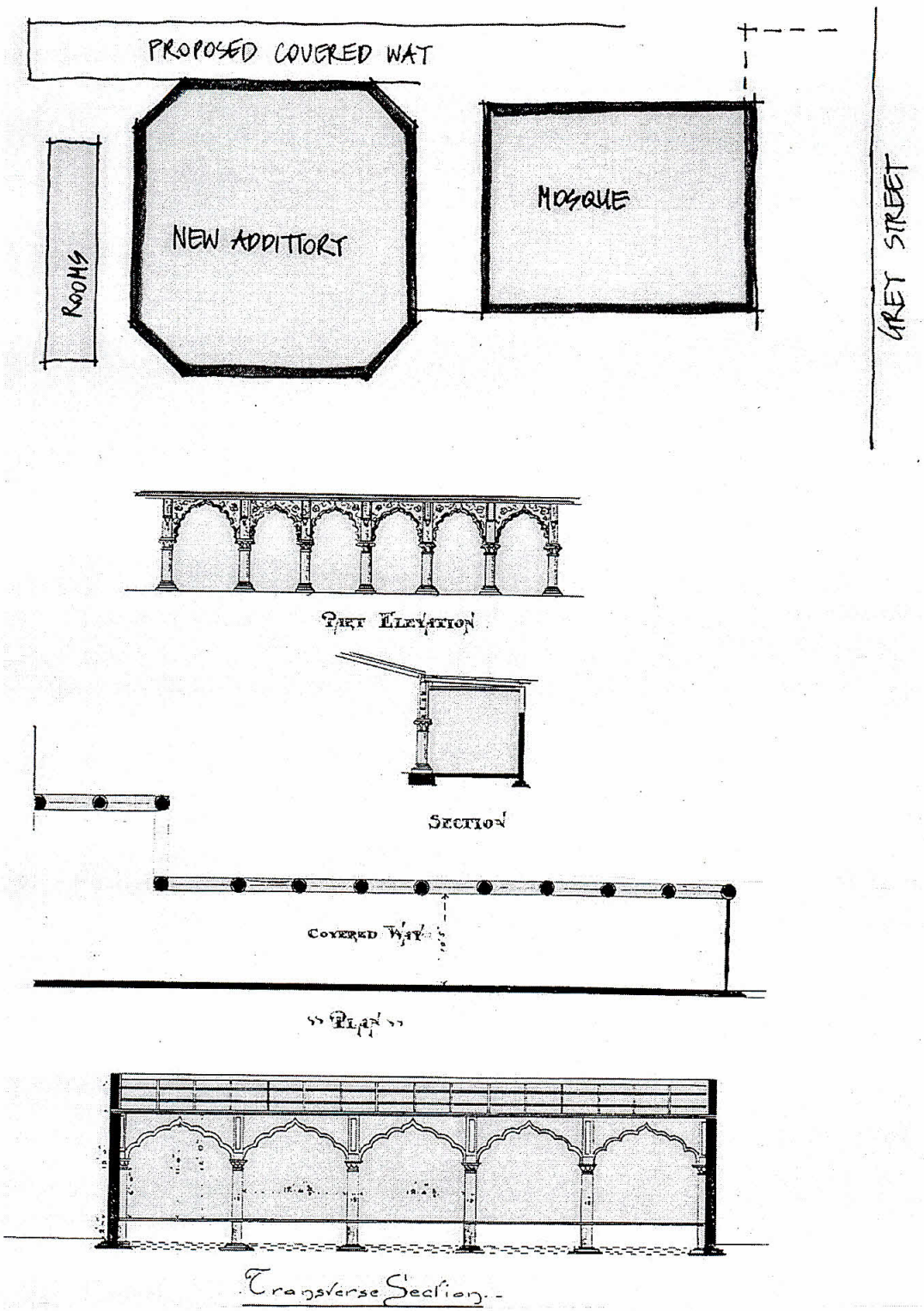


Fig. 10: Proposed covered way to the Grey Street Mosque (Jumma Masjid) for Madressa Trustees illustrates the variety of Islamic symbolism and aesthetics bringing the oriental character to Durban, 1903. (Source: Barrie Biemann Architectural Library, Durban, South Africa).

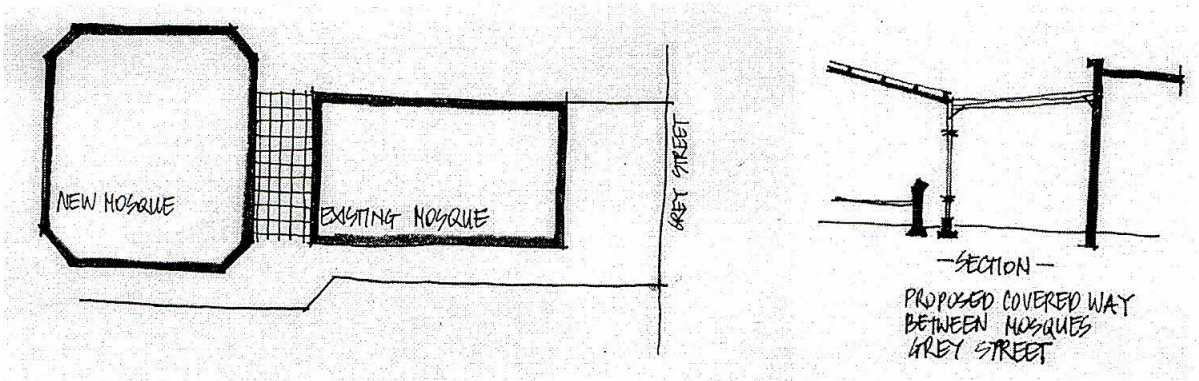


Fig. 11: Proposed covered way between the Grey Street Mosques (Juma Masjid) illustrate the attention given to ventilation and sheltered exteriors, 1903. (Source: Barrie Biemann Architectural Library, Durban, South Africa).

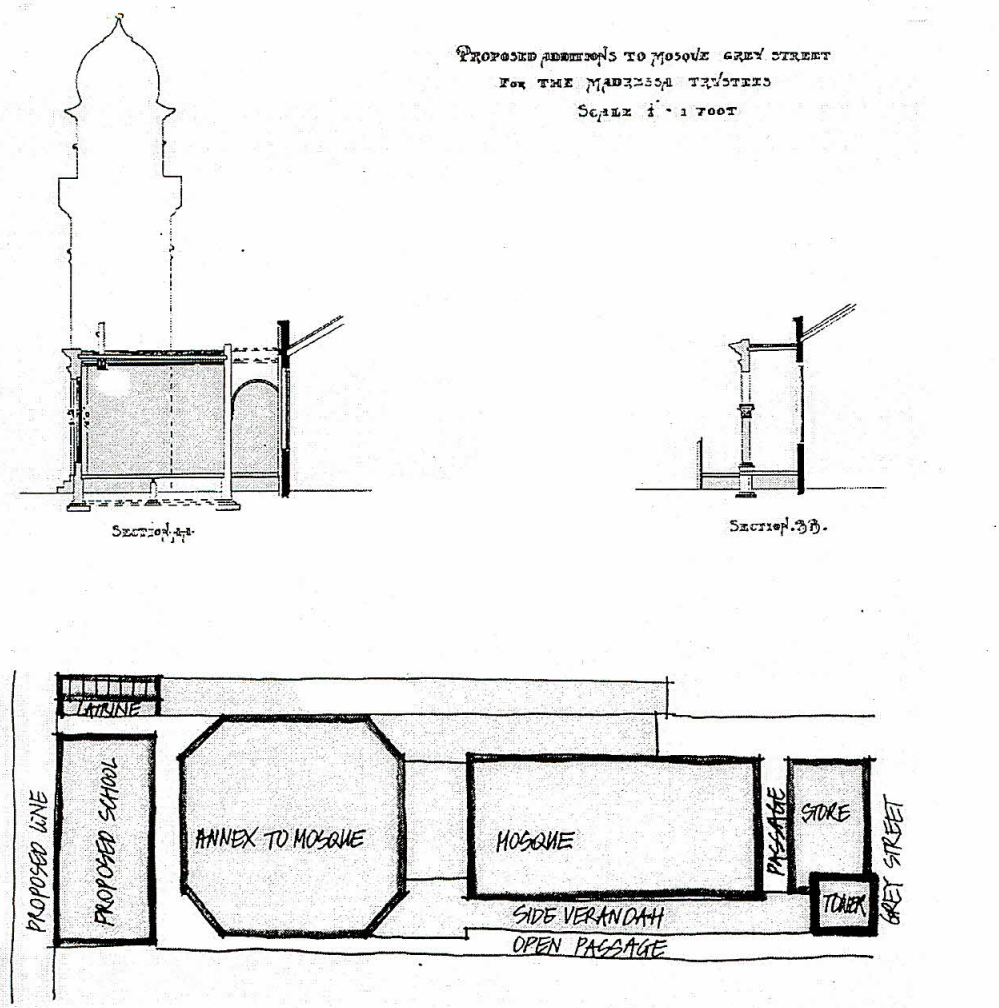


Fig. 12: Proposed covered way between the Grey Street Mosques (Juma Masjid) for the Madressa Trustees, the site plan and section submitted for approval in 1903 illustrate ventilation and sun control as well as acoustic screening. (Source: Barrie Biemann Architectural Library, Durban, South Africa).

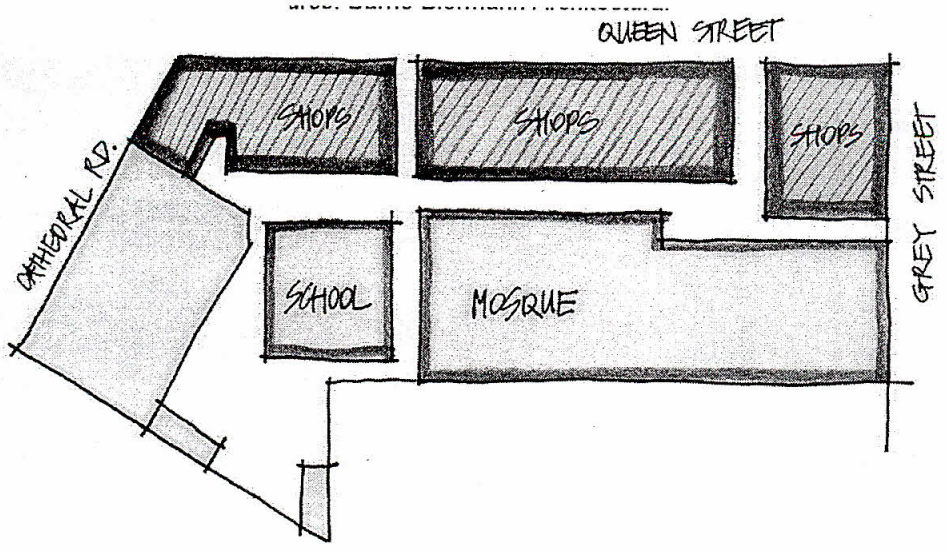


Fig. 13: Proposed shops and flats addition to the Grey Street Mosque (Juma Masjid) created a Buffer to satisfy the need for privacy and quiet during prayer. The site plan submitted for approval in June 1927. (Source: Barrie Biemann Architectural Library, Durban, South Africa).

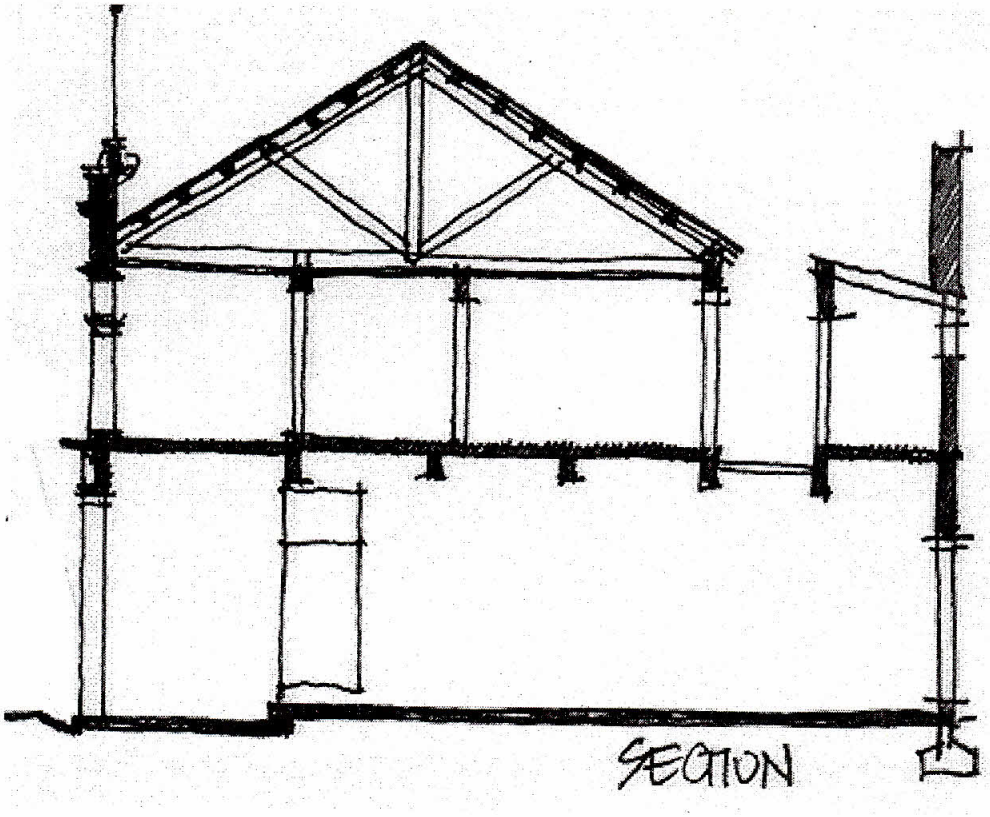


Fig. 14: Proposed shops and flats addition to the Grey Street Mosque (Jumma Masjid) created a Buffer to satisfy the need for privacy and quiet during prayer. The section illustrates the attention given to ventilation, sun control and acoustic screening submitted for approval in June 1927. (Source: Architectural Library, Durban,South Africa).

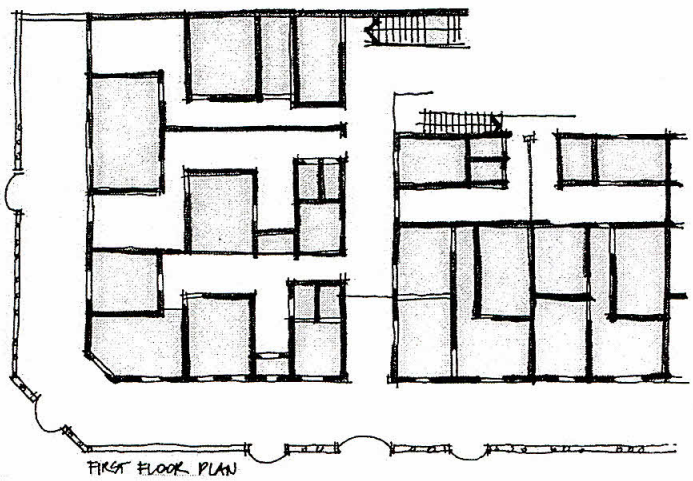


Fig. 15: Proposed shops and flats addition to the Grey Street Mosque (Juma Masjid) created a buffer to satisfy the need for privacy and silence during prayer. First floor plan with comment regarding ventilation and circulation, as submitted for approval in June 1927. (Source: Barrie Biermann Architectural Library, Durban, South Africa).

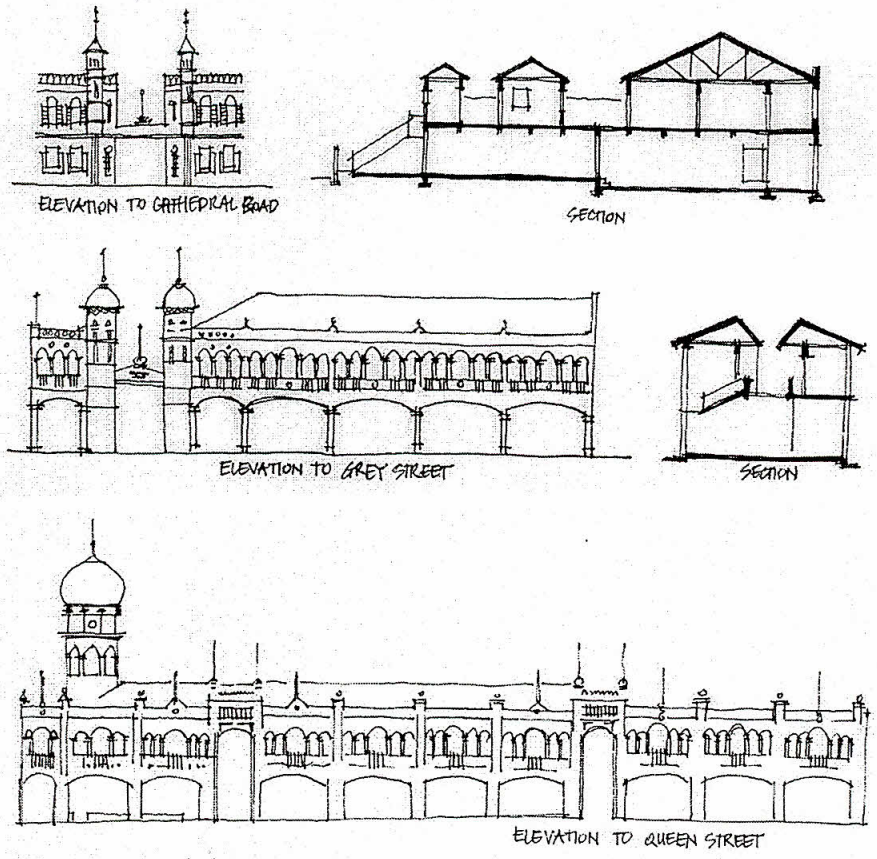


Fig. 16: Proposed shops and flats addition to the Grey Street Mosque (Juma Masjid) created a buffer to satisfy the need for privacy and quiet during prayer. Elevations and sections illustrating ventilation and sun control as well as acoustic, as submitted for approval in June 1927. (Source: Barrie Biermann Architectural Library, Durban, South Africa).

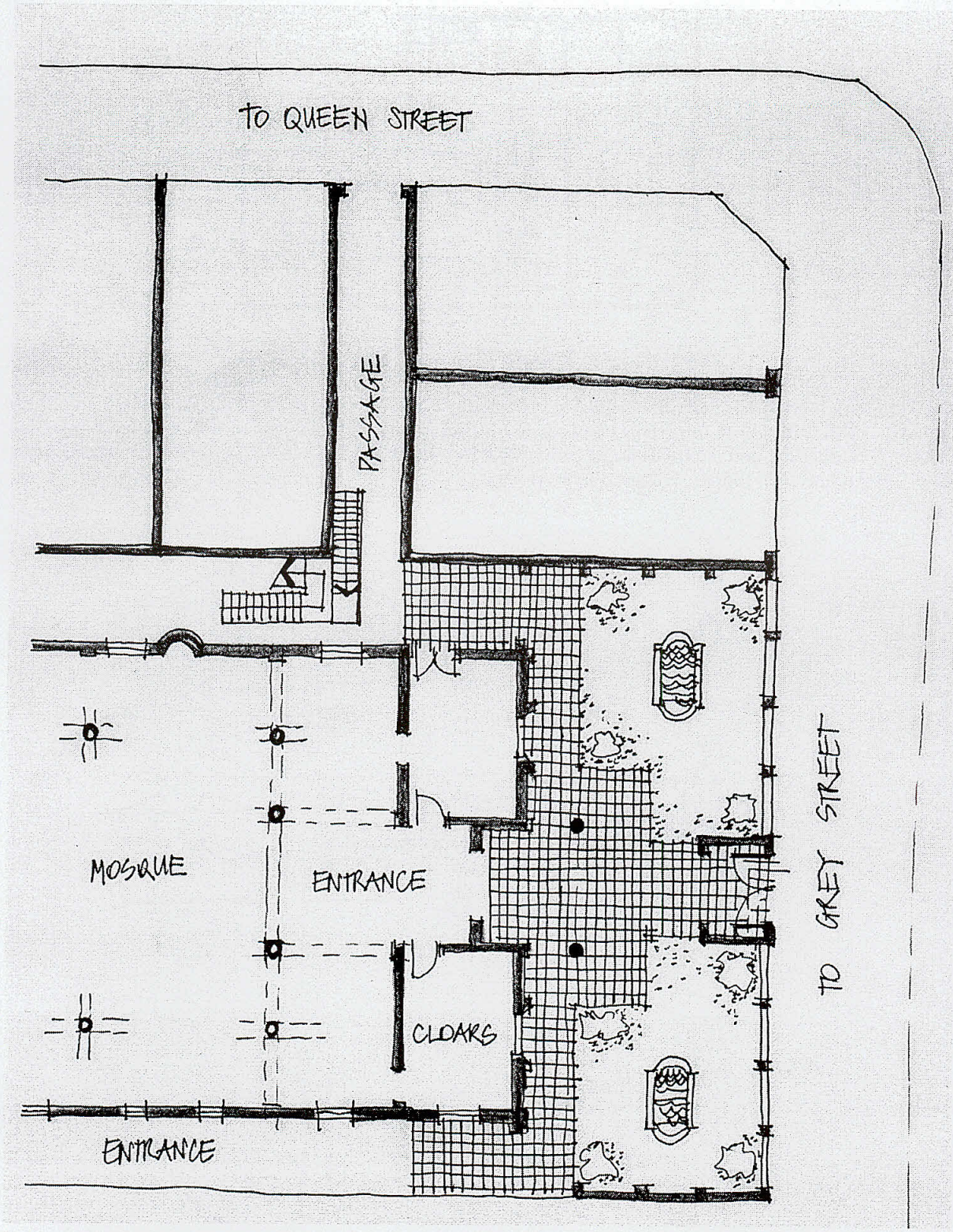


Fig. 17: The present Grey Street Mosque (Juma Masjid) designed by architect William Barboure (completed in 1943), a part of the plan submitted form approval in 1941. (Source: Barrie Biermann Architectural Library, Durban, South Africa).

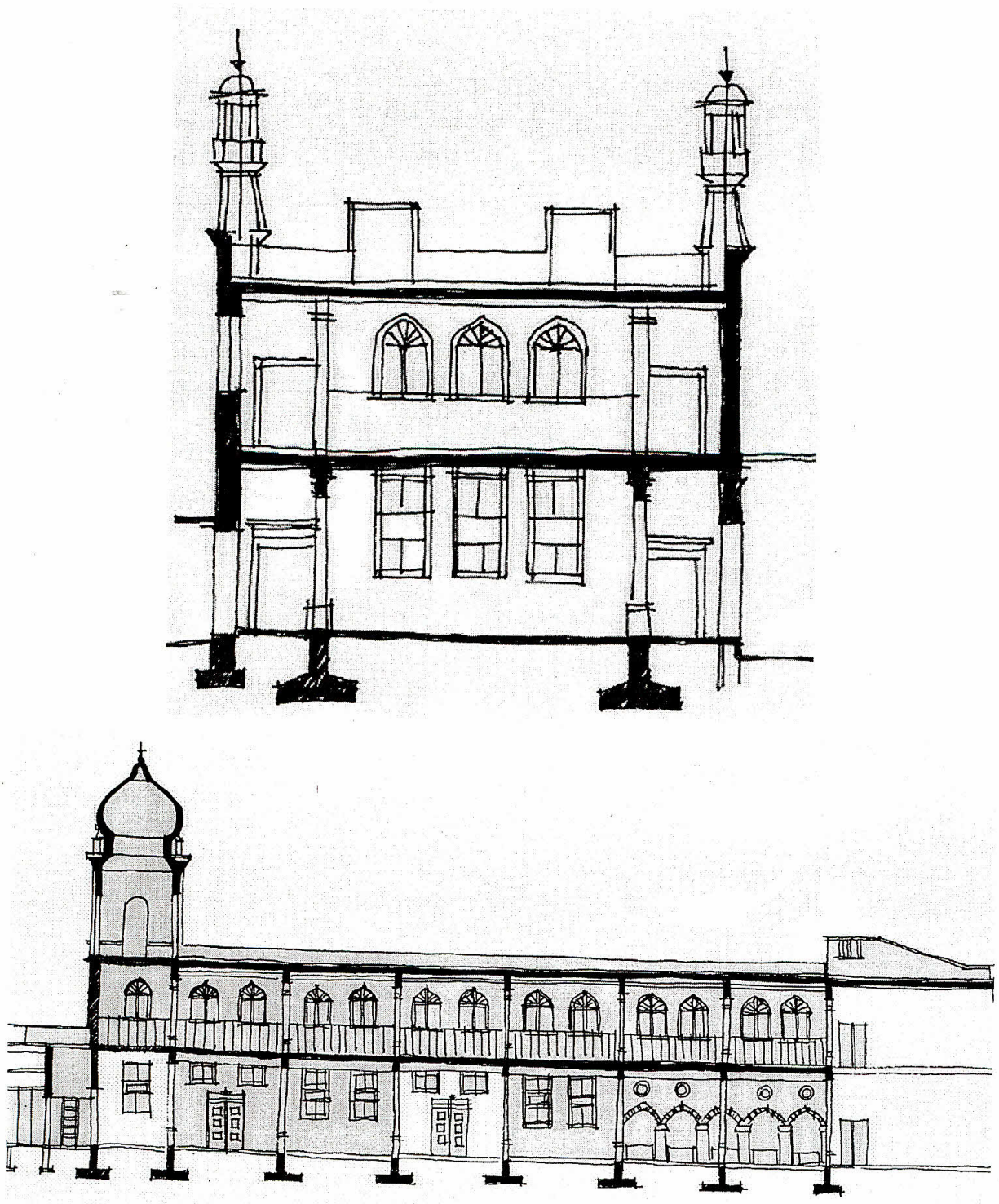


Fig. 18: The present Grey Street Mosque (Juma Masjid) designed by architect William Barboure (completed in 1943). Sections submitted for approval in 1941 illustrate Ventilation tower and details. The roofs is used as a play space for the place of study and as overflow space for prayer – tradition of environmental design satisfying modern approach to roof design. (Source: Barrie Biermann Architectural Library, Durban, South Africa).

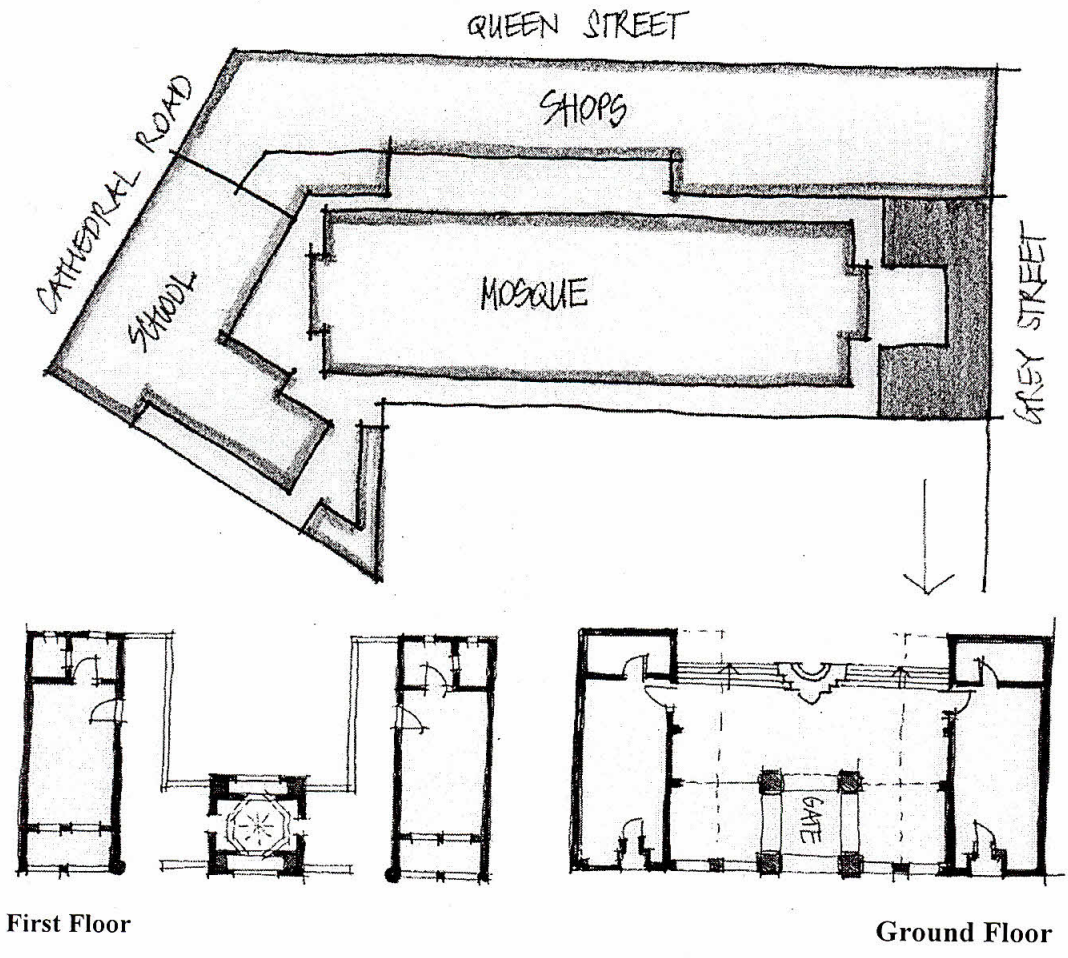


Fig. 19: Proposed New Courtyard of the Grey Street Mosque (Juma Masjid) Minaret Entrance Gate to Grey Street - the last effort to make a courtyard design to create privacy and quiet as well as informal social space. Drawings of site as well as ground and first floor plans as submitted for approval in 1961. Source: Barrie Biermann Architectural Library, Durban, South Africa).

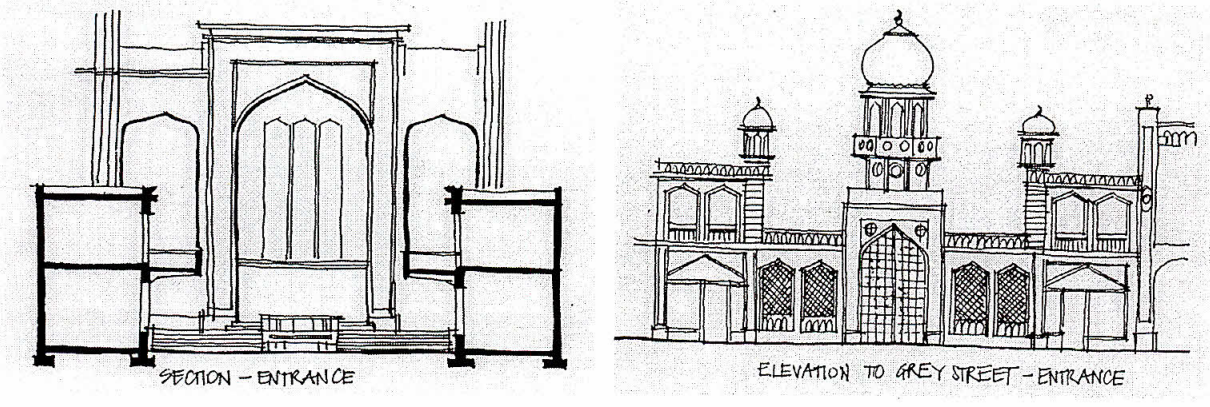


Fig. 20: Proposed New Courtyard of the Grey Street Mosque (Juma Masjid) Minaret Entrance Gate to Grey Street - the last effort to courtyard design to create privacy and silence as well as informal social space. Drawings of sections and elevations submitted for approval in 1961. (Source: Barrie Biermann Architectural Library, Durban, South Africa).

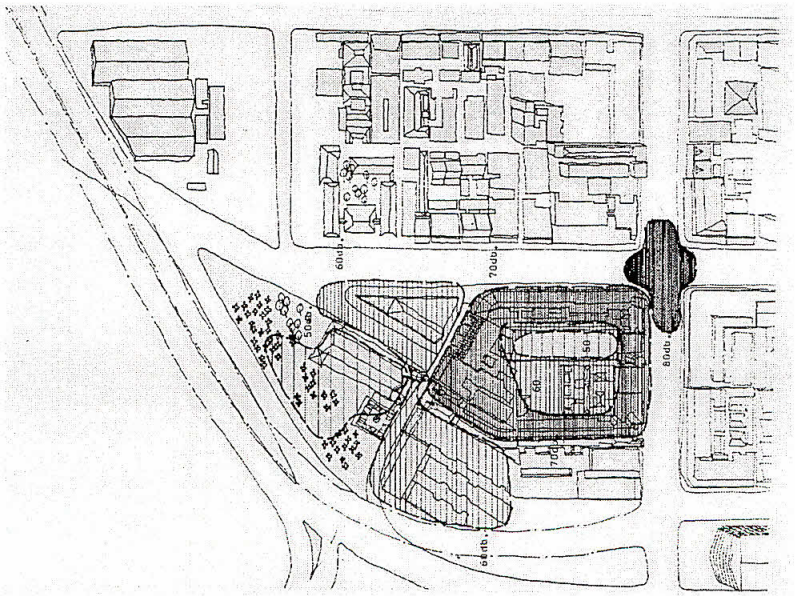


Fig. 21: Noise levels study for the Grey Street Mosque (Juma Masjid) for the peak level on Saturday morning showing the quietest area for praying. (Source: Mills S.J., The Grey Street Mosque Precinct: A Study in Urban Renewal, student thesis, Barrie Biermann Architectural Library, Durban, South Africa).

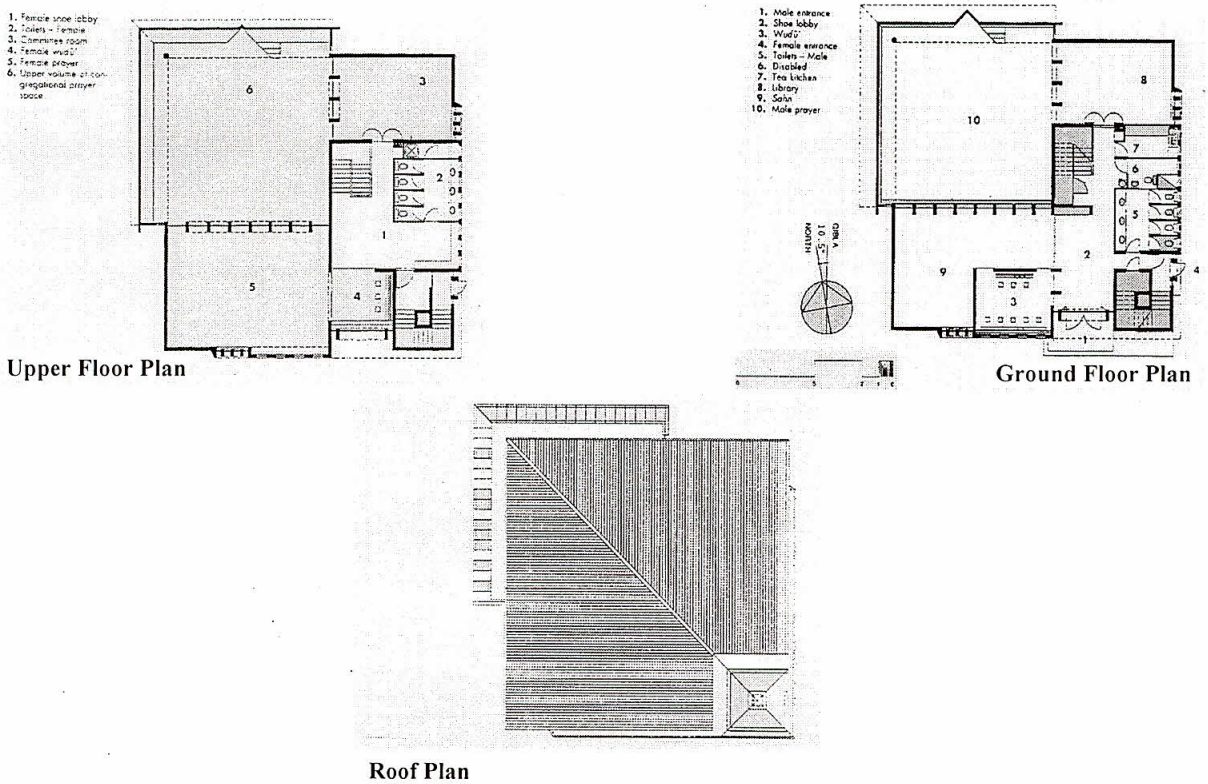


Fig. 22: The University of Natal Mosque (Jama'at Khanah) design by Architects Collaborative cc (arch. Yusuf Patel) in 1994. Ground and upper floors as well as roof plan.

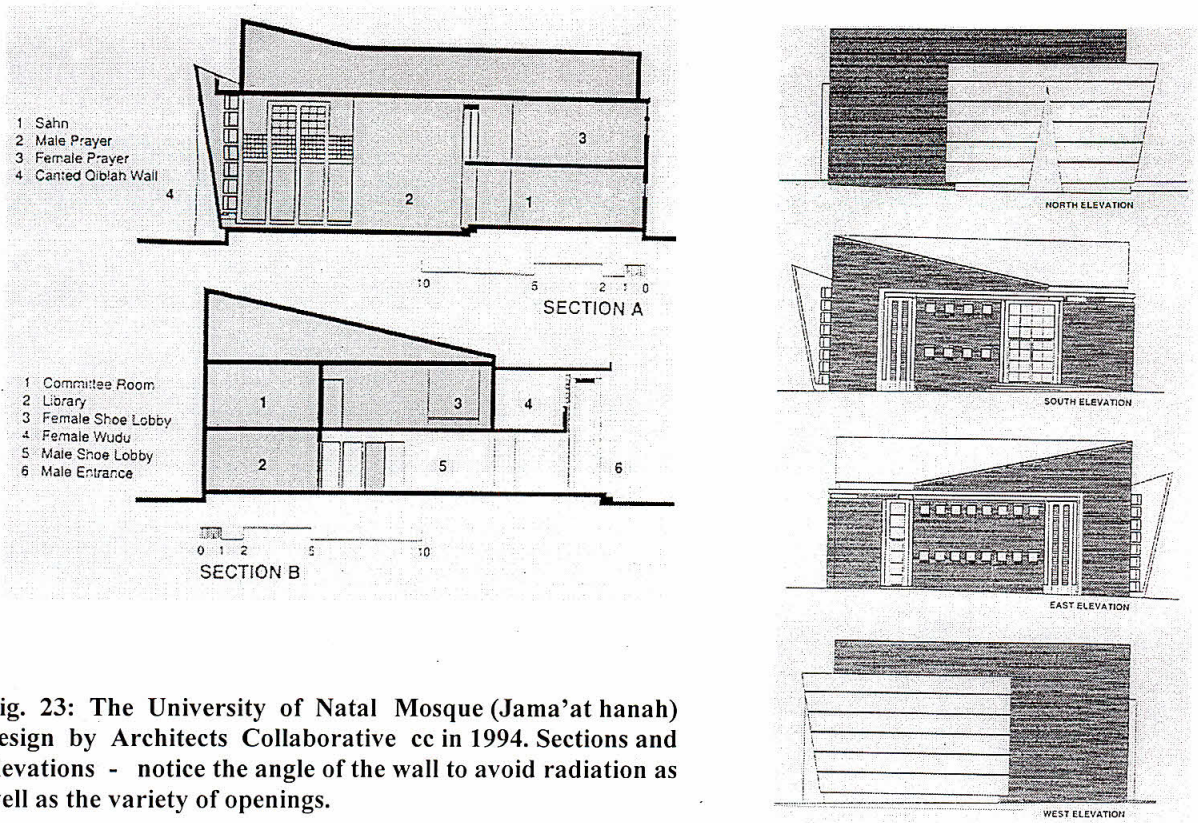


Fig. 23: The University of Natal Mosque (Jama'at hanah) design by Architects Collaborative cc in 1994. Sections and elevations - notice the angle of the wall to avoid radiation as well as the variety of openings.

The thick concrete north wall has the angle to avoid radiation (Figs. 24 & 25) and there are of variety of openings and small wholes left after the construction, which additionally provide constant ventilation. "Whirly bird" ventilators enhance the flow of air.

A minaret was not acceptable to the University by fortunately it is not an obligatory feature. Islamic religious buildings are "hidden architecture". Mosques are not seen as monuments but rather as places of worship. Environmental response to surrounding and materials of Shepstone Building behind (Figs. 26, 27 & 28) has been achieved by use of the face red brick and following Islamic tradition of ceramics and hand worked plaster works.

The University of Natal Mosque does not depend on traditional courtyard, verandas, arcades or porticos but works perfectly in terms of environmental control. The awareness of this necessity allowed the author to create a modern building not losing the tradition of ventilation, sun and acoustic protection. It seems to be one of the most successful buildings on the campus in terms of environmental control.

Conclusion

The two mosques illustrated above proved varieties of different approaches to environmental control.

Mosque architecture following the Islamic tradition should lead to an understanding and meaning of environmental control. The planning and design criteria of mosque architecture should integrate a broad range application of ventilation, solar, acoustic and visual control.

With the continued application of these concerns mosque architecture will continue to be in a better position to declare itself as an important force against environmental hazards. Mosque architecture embraces fourteen centuries of tradition, which has been explored in many different regions all over the world.

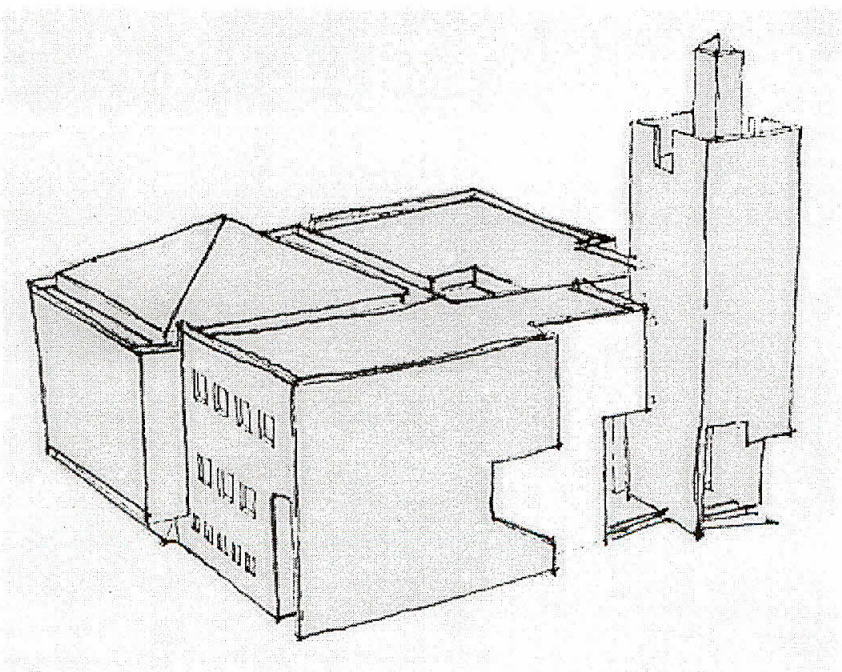


Fig. 24: The University of Natal Mosque (Jama'at Khanah) design by Architects Collaborative cc in 1994. Axonometric of the proposal. The minaret was not acceptable to the University by fortunately it is not obligatory feature. Islamic religious buildings are "hidden architecture". They are not seen as monuments but rather as places of worship. The building has to be experienced internally. (Office drawings).

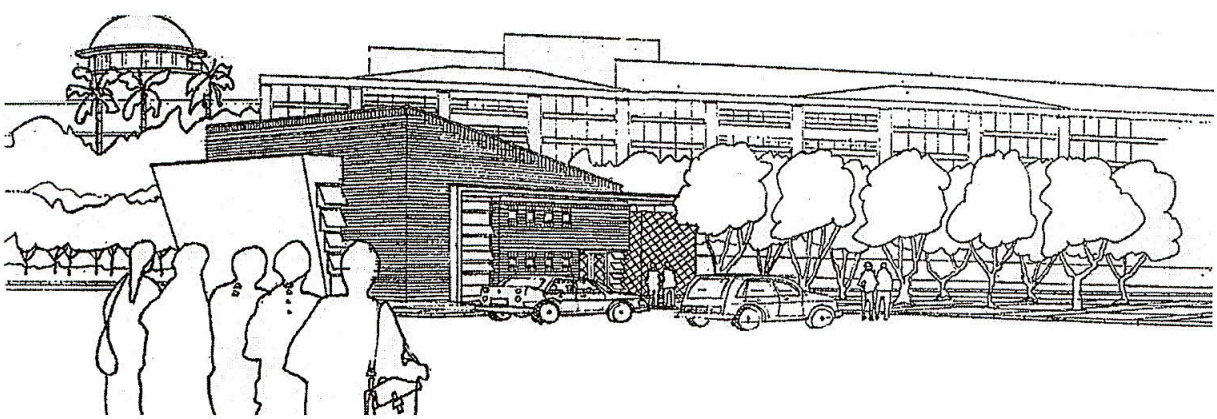


Fig. 25: The University of Natal Mosque (Jama'at Khanah) design by Architects Collaborative cc in 1994. Environmental response to surrounding and materials of Shepstone Building behind. (Office drawings).

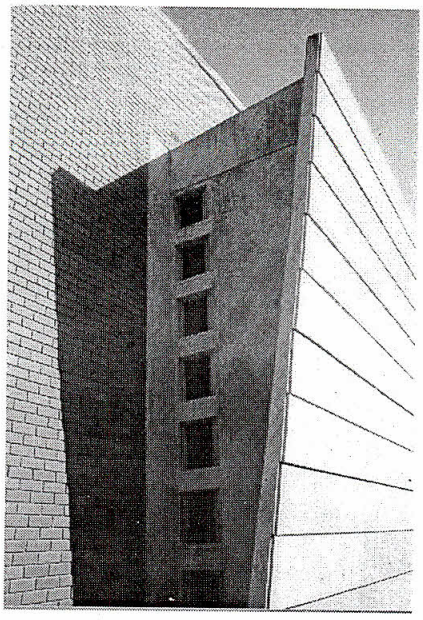


Fig. 26: The University of Natal Mosque (Jama'at Khanah) design by Architects Collaborative cc in 1994 Details of the thick concrete wall avoiding radiation, having additional openings for ventilation as well as creating quiet interior for prayers. (Photos by B. Jekot).

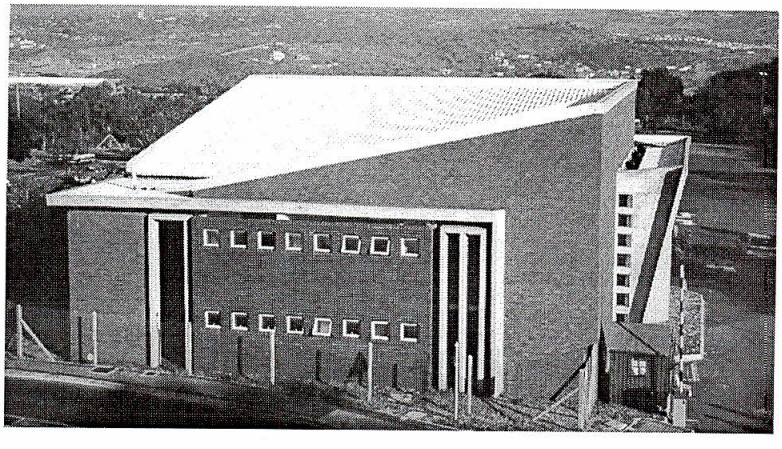


Fig. 27: The University of Natal Mosque. View form above showing installed "whirly bird" ventilators to enable constant additional ventilation (Photos by B. Jekot).

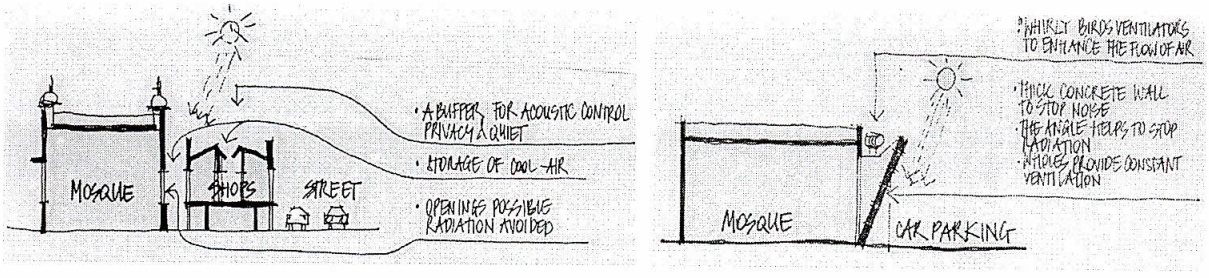


Fig. 28: Two environmental approaches – the Grey Street and the University of Natal Mosques

References

[1] Dangor S. "Muslim Society & Islamic Architecture." *Journal of the KwaZulu-Natal Institute for Architecture*, Volume No. 21, Issue 3, 1996.

[2] Davids A. *The Mosques of Bo-Kaap.* Cape, Institute of Arabic and Islamic Research, Anthlone, 1980.

[3] Davids A. "300 Years - The Cape Muslims and Cape Architecture." *Architecture SA: Journal of the Institute of South African Architects*, July - August 1994.

[4] Fisher R., *le Roux S., de Beer P.* "Editorial Notes." *Architecture SA, Journal of the Institute of South African Architects*, July - August 1994.

[5] Fletcher's. *A History of Architecture.* London: Butterworths, 19th edition, 1987.

[6] Gafoor, M.A. *Two Durban Mosques in Transition. Journal of the KwaZulu-Natal Institute for Architecture*, Volume No 21, Issue 3, 1996.

[7] Givoni B. Man, *Climate and Architecture.* London: Applied Science Publishers Ltd., 2nd edition, 1981

[8] Harber R. "Mosques." *SA. Plan 4/74, Journal for South African Architects*, Vol 4-11, 1974.

[9] Harber R. "From jiha'd to Gti." *Journal of the waZulu-Natal Institute for Architecture*, Volume No 21, Issue 3, 1996.

[10] Kearney B. *Architecture in Natal from 1824 to 1893.* Cape Town: A.A. Balkema, 1973.

[11] Kuban D. *Muslim Religious Architecture part.* Leiden: 1974.

[12] Nuttgens, Patrick. *The Mitchell Beazley Pocket Guide to Architecture.* London: Mitchell Beazley International Ltd., 1992.

[13] Ross, R. *The Cape of Toments - Slavery and Resistance in South Africa*, London: Routledge and Kegan Paul, 1983.

التحكم البيئي: وجهة نظر في تصميم المسجد
لأمثلة مختارة من ديربان وكوازولو – ناتال جنوب أفريقيا

بربارا جيكوت

كلية العمارة ، جامعة ناتال

دربان, جنوب أفريقيا

ملخص البحث: يعاني الناس في دربان من المناخ شبه الاستوائي الحار وبخاصة من الرطوبة. لذلك فإن التهوية الفاعلة والمستمرة هي من أول متطلبات الراحة. وتمثل الحماية من الشمس والأمطار والحشرات ووقف ارتفاع درجة الحرارة الداخلية خلال اليوم أهم المؤثرات في تصميم المبنى. ويقدم جامع قري ستريت ومسجد جامعة ناتال مدخلين مختلفين لحل هذه المشكلة.

ويمكن لعمارة المسجد المتبعة للتقاليد الإسلامية من الوصول إلى فهم معنى التحكم البيئي في التصميم وذلك من خلال تكامل المعايير التخطيطية والتصميمية مع تطبيقات التحكم في التهوية والحماية من الإشعاع والمعالجات السمعية والبصرية. وبالتطبيق المستمر لهذه الأشياء فإن عمارة المساجد سوف تأخذ وضعها كقوة فاعله في حماية البيئة من الآثار السالبة . ذلك لأن عمارة المساجد تحمل بين طياتها أربعة عشر قرنا من التقاليد والقيم الحضارية المعروفة في كثير من مناطق العالم.