A SURVEY OF MAN-MADE TIDAL SWIMMING POOLS ALONG THE SOUTH AFRICAN COAST

by

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1. INTRODUCTION

A large number of man-made tidal swimming pools (two examples are shown in Figure 1) exist along the South African coast. They are usually situated on rocky outcrops in the close vicinity of popular sandy bathing beaches to provide protected bathing conditions in these areas mainly for children and elderly people. Some tidal pools, especially along rocky coast, provide the only safe bathing facilities. Besides affording protection against waves and surfzone currents the pools provide protection from sharks. A large number of tidal pools were built during the early 1950s along the Natal South Coast after the occurrence of a relatively large number of shark attacks on bathers on that coast.

The semi-diurnal tide with a range of about 1,5 m along the South African coast makes it possible for pools to be built such that water replenishment can occur during every high-water (approximately every 12 hours) during both neap and spring tide periods.

Presently, there exists a great need for more tidal pools as part of the demand for more recreational facilities along the South African coast. However, no information on design criteria could be found in the literature.

2. OBJECTIVES

Because of the existing lack of design guidelines for tidal pools it was decided to make a detailed survey of the existing pools. Data obtained from such a survey could then contribute to the first step in identifying factors which should be considered to ensure safe swimming conditions, effective operation of pools, minimum maintenance and minimum impact on the environment.

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SUNSET BEACH TIDAL POOL

STRANDFONTEIN TIDAL POOL

FIGURE 1. EXAMPLES OF TIDAL POOLS

3. METHODS USED

Information on types, physical characteristics, maintenance, operation and usage was obtained from questionnaires sent to local authorities, followed up by discussions with the authorities and by making site visits to the pools.

Detailed observations such as of rate of overtopping versus tidal level were made at 13 of these pools.

Available aerial photographs of pools were also used as a source of information on the location and environment of the pools.

4. RESULTS

4.1 General

Data for 80 tidal pools (about 90 per cent of the existing pools along the 3 000 km coast) were obtained. Most of these pools are situated in the more highly developed coastal areas i.e. the Cape Peninsula, Natal South coast, Port Elizabeth and East London areas. The distribution of tidal pools along the South African coast is shown in Figure 2. It was found that tidal pools play an important role in providing safe bathing conditions. On rocky coasts and dangerous sandy beaches tidal pools provide, in many cases, the only safe bathing conditions, and where a safe bathing beach for adults exists, a tidal pool close to it can provide in the important need of safe bathing conditions for small children.

4.2 Types

Two basic types of pools could be distinguished:

(i) Pools which are partly enclosed by walls. The landward sides of these pools consist of sandy beaches.

(ii) Pools which are fully enclosed by walls. These are either attached to the shore or can become detached from the shore during the high water.

Figure 3 illustrates schematically the different types. The pools which are partly enclosed by walls are usually situated on beaches with relatively flat slopes. (See a, Figure 3). Their walls enclave part of the beach so that the depth in the pool varies from zero at the beach to the maximum depth of the pool at the seaward side. Wall crest levels of these pools are relatively low so that they usually do not significantly interrupt the longshore sediment movement in the beach zone. The pools which are fully enclosed by walls are usually situated on beaches with relatively steeper slopes. Pool b in Figure 3 illustrates the detached type and pool d the type attached to the beach with relatively high walls which exclude the beach from the pool and reach up to the primary dune. The semi-detached type (c, Figure 3) tends to intercept the longshore sediment transport on the beach with a consequent sand build-up next to the pool. The sand build-up can be of such an extent that large quantities of sand can eventually enter the pool.

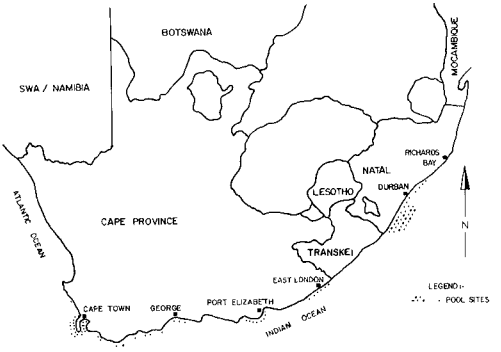

FIGURE 2: DISTRIBUTION OF TIDAL POOLS ALONG THE SOUTH AFRICAN COAST.

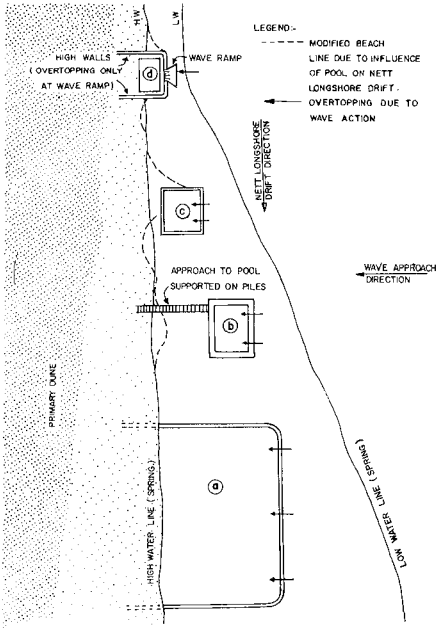

FIGURE 3: SCHEMATIZATION OF TYPES OF POOLS

4.3 Physical Characteristics

The walls of all pools (mostly of mass concrete) are founded on rock except in one case where the walls are partly founded on steel sheet piles driven 6 m into sand. (Besides serving as a foundation support to the wall the sheet piles also limit seepage of water from the pool). The foundation level of the walls are in most cases above the mean low spring tidal level.

Distributions of pool water area, wall crest level and maximum pool depth for the majority of the pools in Natal and Cape Province are shown in Figures 4, 5 and 6 respectively and the dominant ranges of these are summarized in the table below:

Parameter	Natal	Cape Province
Water area (m^2)	500 - 1 000	500 - 1 500
Wall crest level (m above mean sea level)	1,0 - 2,0	0,5 - 1,5
Maximum pool depth (m)	1,25 - 2,0	1,25 - 2,25

The wall crest levels of most of the pools are above the mean high water spring tidal level with the predominance of crest levels about 0,1 m to 0,5 m above mean high water spring level.

The majority of the pool walls facing the approaching waves have seaward slopes between 2:1 and vertical and crest widths between 0,4 m and 1,0 m.

Pool floors consist usually of either sand or rock or a combination of the two. Some pools have concrete floors.

All pools are provided with drain pipes at the lowest position in the pool to allow drainage during low water spring tides.

4.4 Operation

Detailed observations made of 13 pools showed that the rate of water inflow due to wave overtopping as well as the tidal level at which inflow commences is largely influenced by the location of the pool (namely, whether protected from wave attack by shallow rocky outcrops or whether exposed to large waves).

Other important factors influencing inflow are tidal level, wall crest level, offshore wave conditions and local wind conditions.

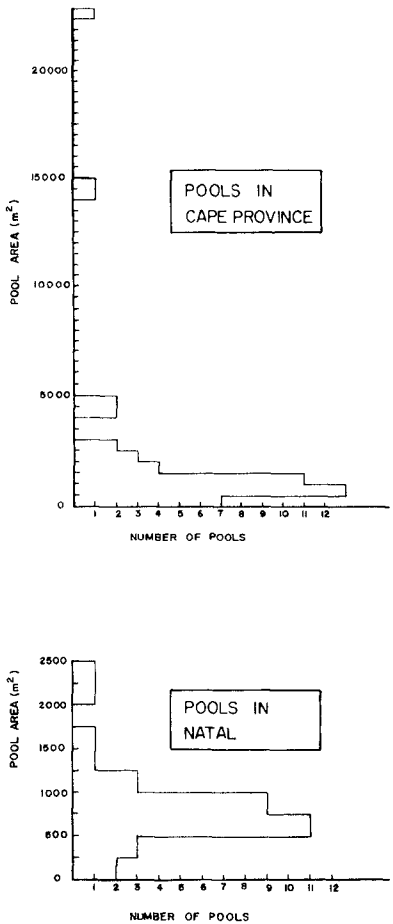

FIGURE 4: DISTRIBUTION OF POOL AREAS

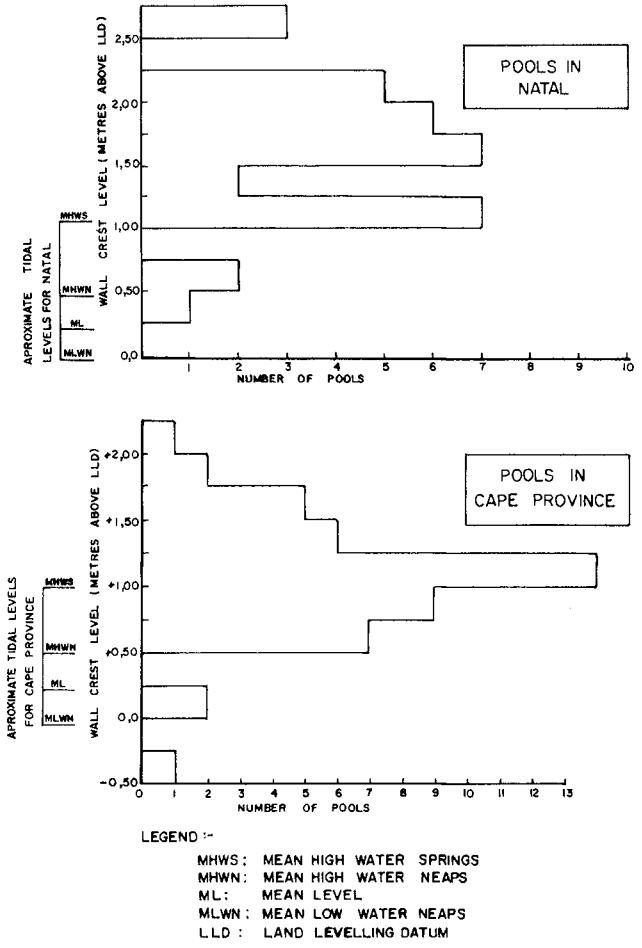

FIGURE 5: DISTRIBUTION OF WALL CREST LEVELS

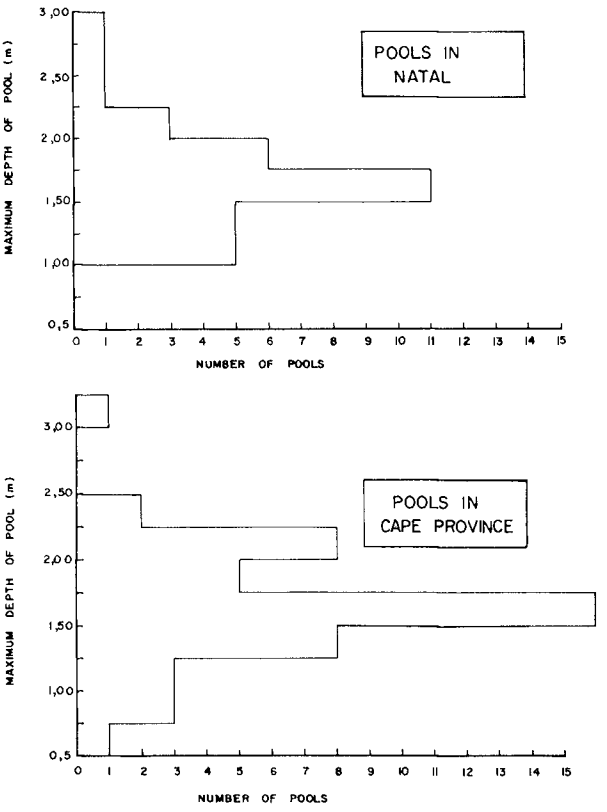

FIGURE 6: DISTRIBUTION OF MAXIMUM DEPTHS OF POOLS

Because of the above many factors, a large range in the water inflows during high water spring tide of between 20 and 650 m^3 per m length of wall was recorded.

4.5 Maintenance

A large number of pools are drained fortnightly to clean the pools, remove accumulated sand and to enable the rock and concrete surfaces to be washed with lime to control the growth of slippery algae. Other chemicals used to control algal growth are carbide and copper sulphate.

Several well-sited pools with low crest levels are self maintaining since inflow is frequent and sufficient to minimize the growth of algae and sand accumulation. These pools are usually submerged during high water spring tides.

4.6 Problems

A few pools are frequently sanded up due mainly to incorrect siting. Two of these are sanded up to such an extent that they are out of use.

Water replenishment at about eight of the pools is considered to be insufficient. This leads to stagnant water conditions and excessive algal growth.

Some of the pools are dangerous since bathers can be washed from side or back walls out to sea.

Parts of walls of three of the pools have been destroyed by waves. This was probably due to weak walls and improper bonding between wall and rock foundation.

5. DESIGN FACTORS TO BE CONSIDERED

The study indicated a number of factors which should be considered in the design of a recreational tidal swimming pool.

(a) The needs of the bathers: It should be established whether provision should be made for small children as well as adults and the type of bathing (e.g. swimming, diving, playing etc.) required by the bathers.

(b) The siting of the pool: The pool should preferably be situated so that the walls can be founded on rock where possible. Where no rock foundation is present sheet piling could be considered as a foundation for the walls. Seasonal variation of the beach profile as well as longshore sediment transport in the beach zone should be considered in the siting to prevent the pool from being sanded up.

Sufficient consideration should also be given to the aesthetic and ecological considerations to minimize the impact of the structure on the environment.

(c) Water replenishment by wave action: Sufficient quantities of

fresh sea water should enter the pool frequently enough and overflows should be situated so that adequate renewal of water throughout the pool is ensured. A general criterion for inflow would be to stipulate that inflow should occur at least during high water neap tides with dominant wave conditions. The walls should be built rather too low than too high since it will be easier to raise the walls if this is afterwards found to be necessary. The seaward slope of the wave-facing wall should be about 2 horizontally on 1 vertically or flatter since flatter slopes increase overtopping and stability.

(d) Safety: The pool floor should be even and if the pool is not of uniform depth the slopes should be gentle. Situations where overwash from walls to sea can occur which could be a danger to bathers should be prevented. Intakes of drain pipes should be covered with grids. Notice boards indicating water depths should be provided.

(e) Maintenance: The floor level of the pool should be above low water springs to allow drainage. It appears to be good practice to whitewash the walls with lime when the pool is cleaned as this apparently retards the growth of algae and shells and also gives the pool an attractive and tidy appearance.