

# Water supply and sewage disposal at Mohenjo-Daro

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The ruined city of Mohenjo-Daro was once a major urban centre of the Harappa Culture or Indus Civilization, one of the Early Bronze Age civilizations which flourished in the north-west of the Indian subcontinent in the second half of the third millennium.

Situated today on the right bank of the Indus about 400km north of Karachi, Pakistan, the present site covers an area of at least 100ha (Fig. 1), but recent discoveries close to the Indus show that structural remains extend at least one mile further east beyond the present site area. Following its discovery in 1922 by R. D. Banerji of the Archaeological Survey of India the site, known locally as Mohenjo-Daro or Mound of the Dead, soon proved to be a rich source of archaeological material. From 1924 onwards large-scale excavations were carried out at the site under the direction of Sir John Marshall, the then Director General of the Archaeological Survey of India.

Bit by bit, the remains of a large, densely built-up urban area were unearthed which, by the end of the official excavation programme in 1931, extended over more than 100,000 square metres, amounting to about one-tenth of the total suspected area of Mohenjo-Daro. Hundreds of dwelling-houses and large buildings, streets and lanes orientated towards the cardinal points testify to the architectural sophistication of what seems to have been a planned city. The idea of a 'planned city', with a grid-iron street plan and a castrum-type layout with 'insulae' was first postulated by Stuart Piggot and later supported by Mortimer Wheeler. Although recent research by the 'Research Project Mohenjo-Daro' (RPM), of the Department of History of Architecture, Aachen, West Germany, has shown that the concept of a grid-iron plan can no longer be upheld, there is no doubt that Mohenjo-Daro was a deliberately planned city. Obviously built within a relatively short period (around 2450 BC), the Harappans erected the buildings on top of gigantic, artificial foundation platforms situated close to the Indus in the middle of the alluvial plain (Jansen et al. 1987).

Nowhere is this sophisticated planning more impressive than in the structural features relating to the water supply and effluent disposal systems. Fresh water was supplied by a network of wells, sunken cylindrical shafts several meters deep built of wedge-shaped, standard-size bricks. The waste water and other sewage of almost every house was channelled into the drain running along the street outside.

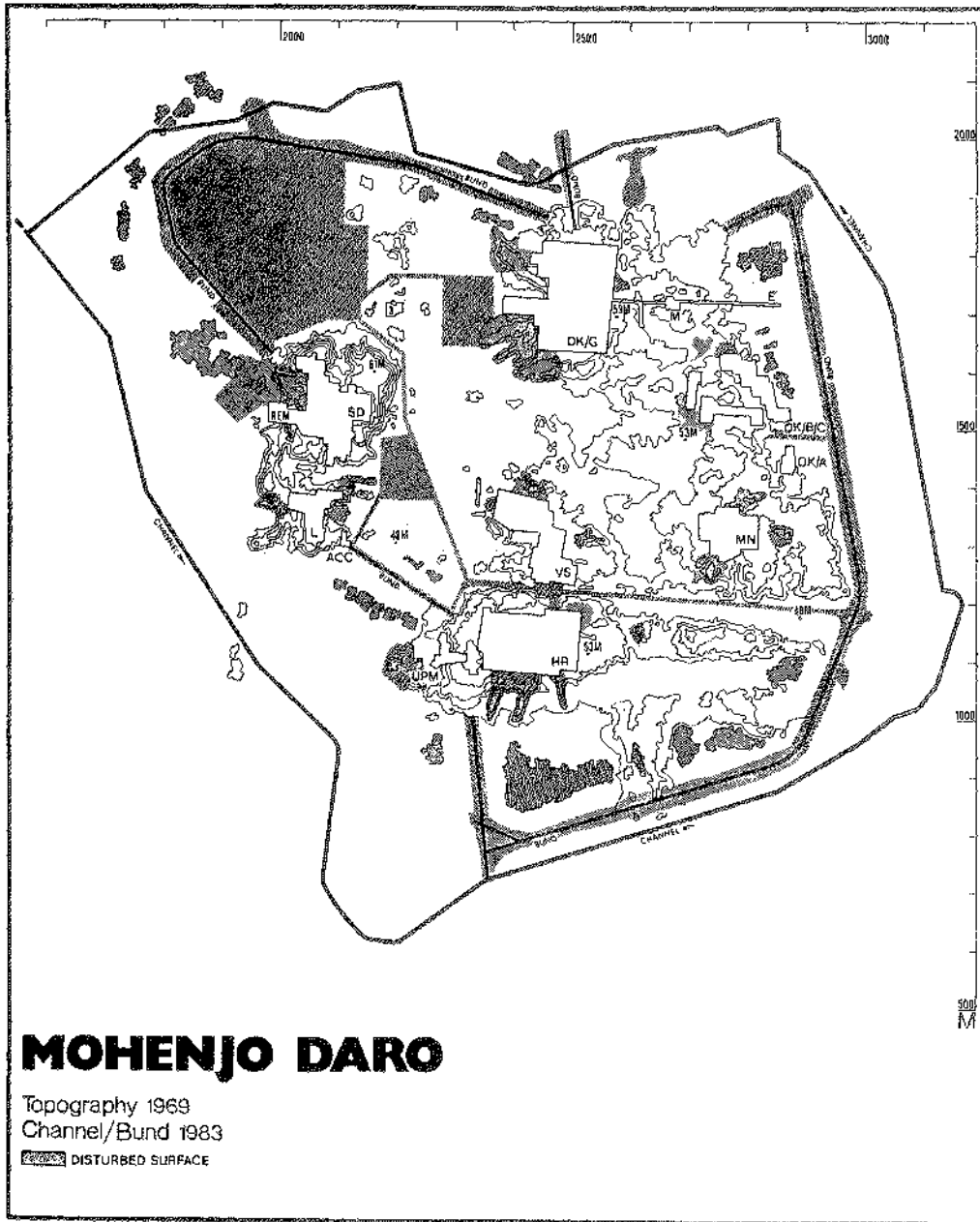


Figure 1 Plan of Mohenjo-Daro.

A standard domestic convenience was the indoor 'bathing platform', a small area of not more than 2 square metres which was paved with specially sawn bricks of high quality and surrounded by a low brick rim to form a shallow basin. A special outlet in the outside wall allowed the effluent to flow into a soak pit or straight into the street drain.

Facilities for disposing of waste water were not entirely unparalleled in other ancient cities, however. That drainage systems were already known in the Late Uruk Period (3300–3200 BC) is proved, for example, by the remains at Habuba Kabira in modern Syria (Strommenger 1980).

In this case the settlement was protected by a wall on three sides and bounded on the fourth, the east, by the river Euphrates. It is obvious that Habuba Kabira was a planned city built on a selected site on elevated ground in the immediate vicinity of the river. Its excavators discovered cylindrical pipes in the ground which had apparently served as drains for waste water. On the other hand, no indication of a vertical water supply by means of wells was found. But pottery drain-pipes are also known from the Hilmand valley site of Shahr-i-Sokhta in the early third millennium (Tosi 1983), and here again no wells could be located within the settlement.

Neither drains nor wells as part of a settlement infrastructure are reported from any of the 'Early or Pre-Harappan' cultures in the north-west of the Indian subcontinent. In general, vertical water supply systems appear to have been practically unknown in the early urban cultures emerging at this period.

In view of this fact, it is all the more astonishing that the Harappan 'urban phenomenon' seems to have been accompanied by fully developed, built-in water supply and effluent disposal systems, and that evidence of these installations has turned up in every Mature Harappan settlement investigated to date (Jansen et al. 1987: 128).

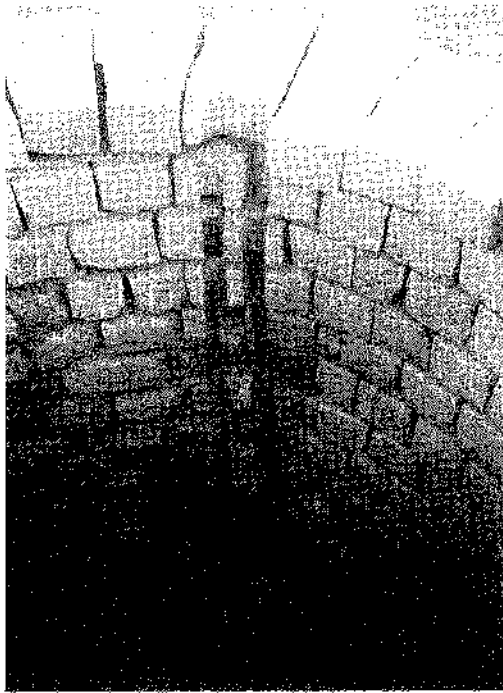
The most detailed data are available from Mohenjo-Daro, which in this respect proved to be an almost undisturbed site.

### **The Mohenjo-Daro water supply**

The townspeople were supplied with fresh water exclusively by means of wells, vertically built (or sunken) brick shafts inside the urban area. The Great Bath in Mohenjo-Daro cannot be regarded as a cistern used for storing fresh water as part of the supply system. Similarly, the so-called 'tank' in Lothal, Gujarat, is traditionally interpreted as a harbour or dock for ships.

To accommodate the smaller inner radius of the cylindrical well shaft the wells were built of specially designed, wedge-shaped bricks (Pl. 1). From the technical point of view, the cylindrical well shafts are an impressive feat of engineering as they bear out the fact that the circular form is statically that best suited to withstanding the lateral pressure bearing on wells 20m or more deep.

Presumably these circular brick-lined wells were the invention of the Harappan people of the alluvial plain. No evidence for wells has been found so far in an Early or Pre-Harappan site. Even in the cities of contemporary Egypt and Mesopotamia vertical water supply systems were practically unknown. It is all the more astonishing,



*Plate 1* Brick-built well in area HR showing structure and rope marks.

therefore, that an average catchment radius of a mere 25m per well has been estimated for Mohenjo-Daro on the strength of the available data. If this figure is applied by extension to the entire built-up area, including the unexcavated sectors, then Mohenjo-Daro must have been serviced by at least 700 wells, with an average frequency of one in every third house (Fig. 2).

Needless to say, a water supply network on this scale within the actual city itself was unheard of at this period. Contemporary Egyptians and Mesopotamians, for instance, had to make do with fetching water bucket-by-bucket from the river and then storing it in tanks at home in the city until needed.

Apart from the very fact of knowing about a vertical water supply system, which could conceivably have occurred to the Harappans through their experience in extracting potter's clay from deep pits, it was, by any standards, a considerable technical accomplishment to install them within the urban area and to line them with wedge-shaped bricks in circular form. And yet, although they were obviously familiar with the circle as statically the optimum structural form to withstand lateral pressure, it did not occur to the Harappans to go one step further and halve such a brick cylinder, tilt it 90 degrees, and thus invent the true barrel vault. As far as we know, the corbel vault was the only structural device used by the Harappans to bridge larger openings in brick masonry, e.g. for covering drains and roofing doorways.

Naturally such a densely populated city as Mohenjo-Daro could not have survived long in a semi-arid climate without an independent water supply of its own. As the wells demonstrate the townspeople's concern to ensure their self-sufficiency in this

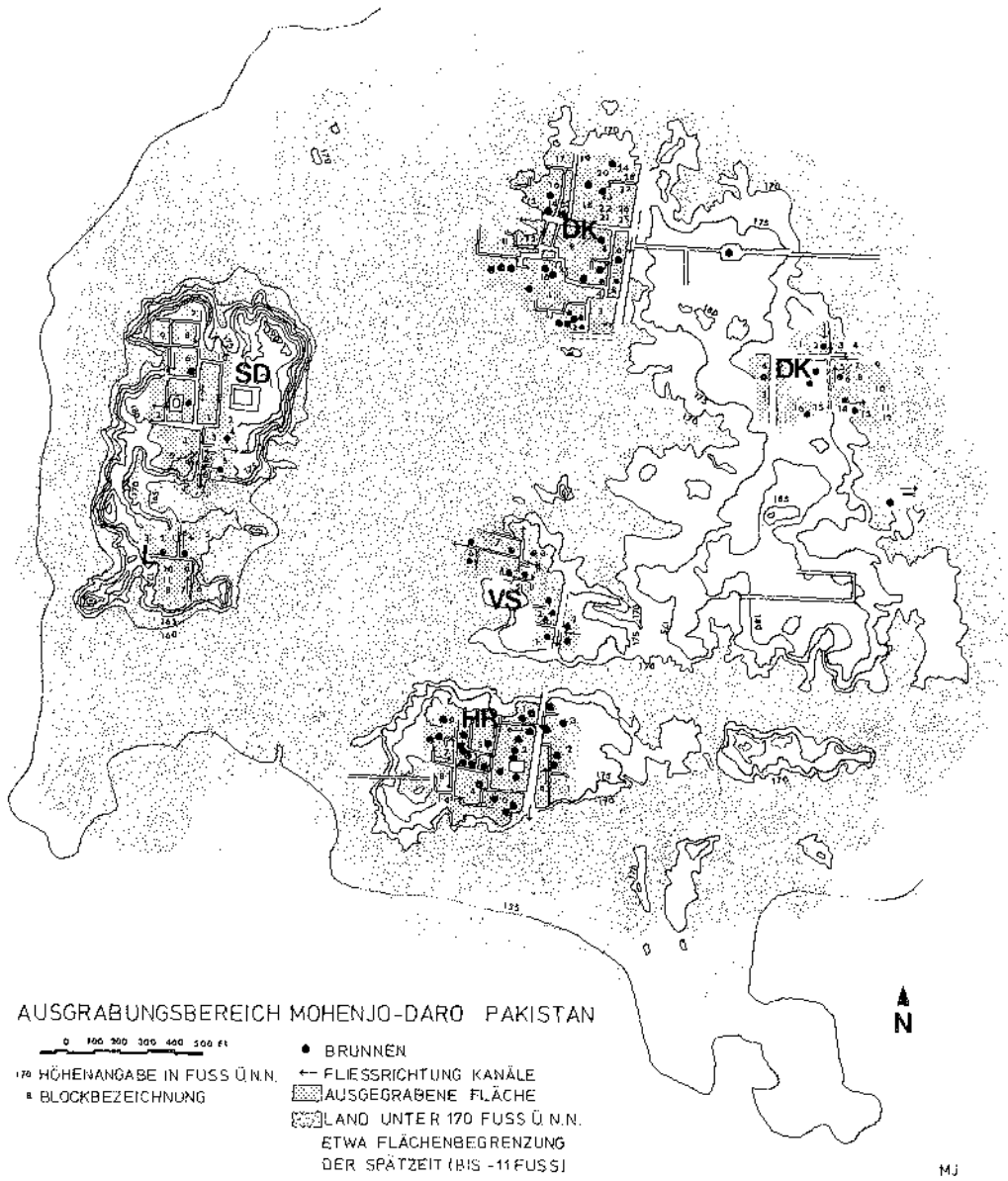


Figure 2 The site of Mohenjo-Daro showing the positions of the wells.

respect, this could be taken to mean that the unpredictable Indus only flowed past the city at irregular intervals.

But it is also possible that the people of Mohenjo-Daro built the wells as a precaution in the event of a siege, on the analogy of the familiar water cisterns installed in hilltop settlements in the less distant past.

However, this rational approach toward what is seen as a merely physical puzzle cannot come up with a satisfactory explanation for the sheer extravagance of the water consumption indicated by the bathing platforms in almost every house and the density of the effluent drain network. It cannot be doubted that the Harappans of Mohenjo-Daro consumed water at such an enormous rate that personal hygiene requirements alone fail to account for it.

It may be presumed that water played a special role in the consciousness of a population group whose agricultural cycle was totally dependent on the annual inundations of the Indus. Possibly the Harappans attributed supernatural powers to the river and considered its water to be sacred, much as the Ganges became a material manifestation of the goddess Ganga in later Hinduism.

Neither is it at all unlikely that the Indus frequently changed course so much so that the city was left stranded beyond the limit of its active floodplain. At such times the water of the Great Bath could have symbolized the permanent presence of the Indus, its life-spring kept supplied by the wells of the city.

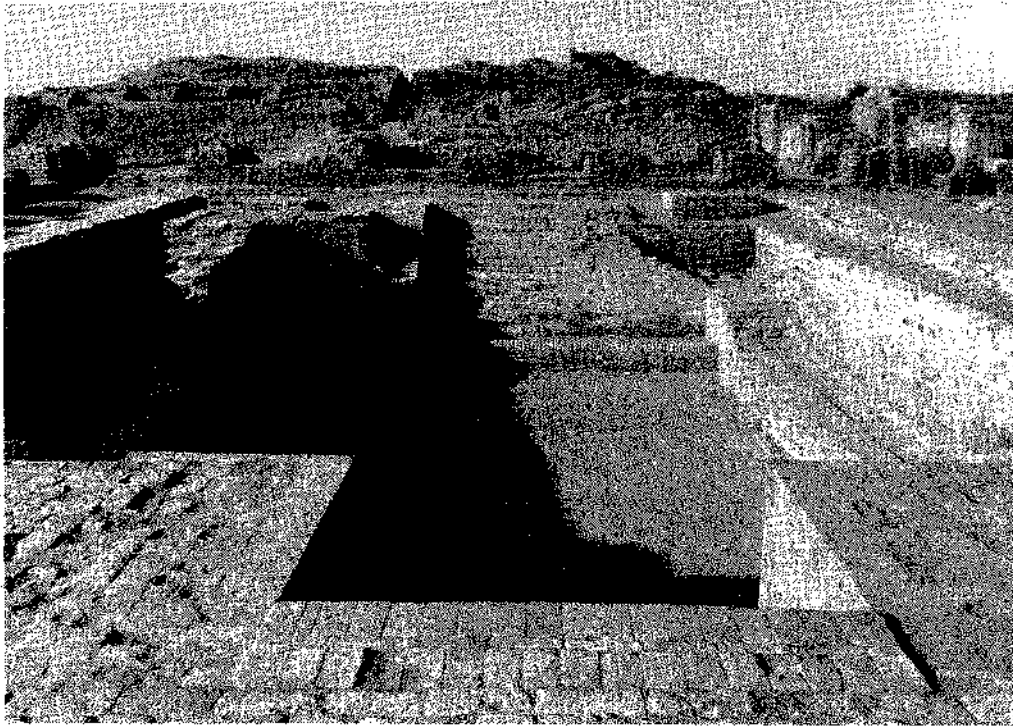
### **Water consumption**

A specifically 'watery' architectural feature is always found in the close vicinity of these wells, normally a small strictly functional 'bathing platform'. The outstanding exception is the only large water-using structure which has been excavated so far at an Indus Civilization site, namely the Great Bath of Mohenjo-Daro (Fig. 3 and Pl. 2).

This remarkable structure with an area of approximately 1,700 square metres (52m north-south × 32.4 east-west) was unearthed in the northern sector of the Acropolis as early as 1925 and received its name from the brick-lined pool in the central courtyard (Jansen 1979: 105 ff.; Jansen and Zäschke 1983).

Together with the many bathing platforms located in the dwelling-houses, the Great Bath is counted as one of the 'water-using' structures characteristic of the Mature Harappan period. Referring to the situation of a neighbouring complex close to further bathing platforms and wells (SD Area, Block 6), Ernest Mackey (1938: 10) remarked: 'In view of its close proximity to the presumably sacred building that lies beneath the stupa, I would suggest that Block I was once the residence of a very high official, possibly the high priest himself, or perhaps a college of priests.' (But for criticism of such a 'speculative interpretation' see Jansen 1979.) Of the other bathing facilities near the Great Bath, a series of eight compartments built in two rows on either side of a central drain, he wrote:

This bathing establishment is one of the most interesting buildings unearthed at Mohenjo-Daro and affords much room for speculation. There can be no doubt that



*Plate 2* The Great Bath from the north.

this group of rooms were used for ablutions . . . Most probably bathing was a religious duty, as with most Indians today, and I am inclined to regard the bathrooms in Block 6 as provided for the members of some kind of priesthood, whereas the general public performed their ablutions in the Great Bath. (Mackay 1938: 20)

As far as the residents of the Acropolis are concerned, Mackay's guess is as good as ours. Suffice it to say that the archaeological evidence does not corroborate his suggestion that the northern sector of the Acropolis was inhabited by priests, nor that the Great Bath was open to the general public.

The Great Bath was not included in the original building plans for the Acropolis but was rather a later intrusion. This can be seen clearly from the way the covered effluent drain of the Great Bath cuts diagonally across the northeastern corner of the lower, older section of the so-called 'granary' adjoining it on the west. In addition, the method of construction of the basin itself with an outer support wall and cross-wall reinforcements indicates it was sunken into older foundations.

The outside walls, up to 2m thick, were built in English bond and tapered upwards at an angle of 80 degrees. The complex was separated from the neighbouring buildings on all sides by a street up to 5m broad, making it the only known single free-standing structure in Mohenjo-Daro which could be walked around outside. At a later period, during which alterations were also made to the interior, this pathway round the perimeter was largely absorbed by secondary buildings.

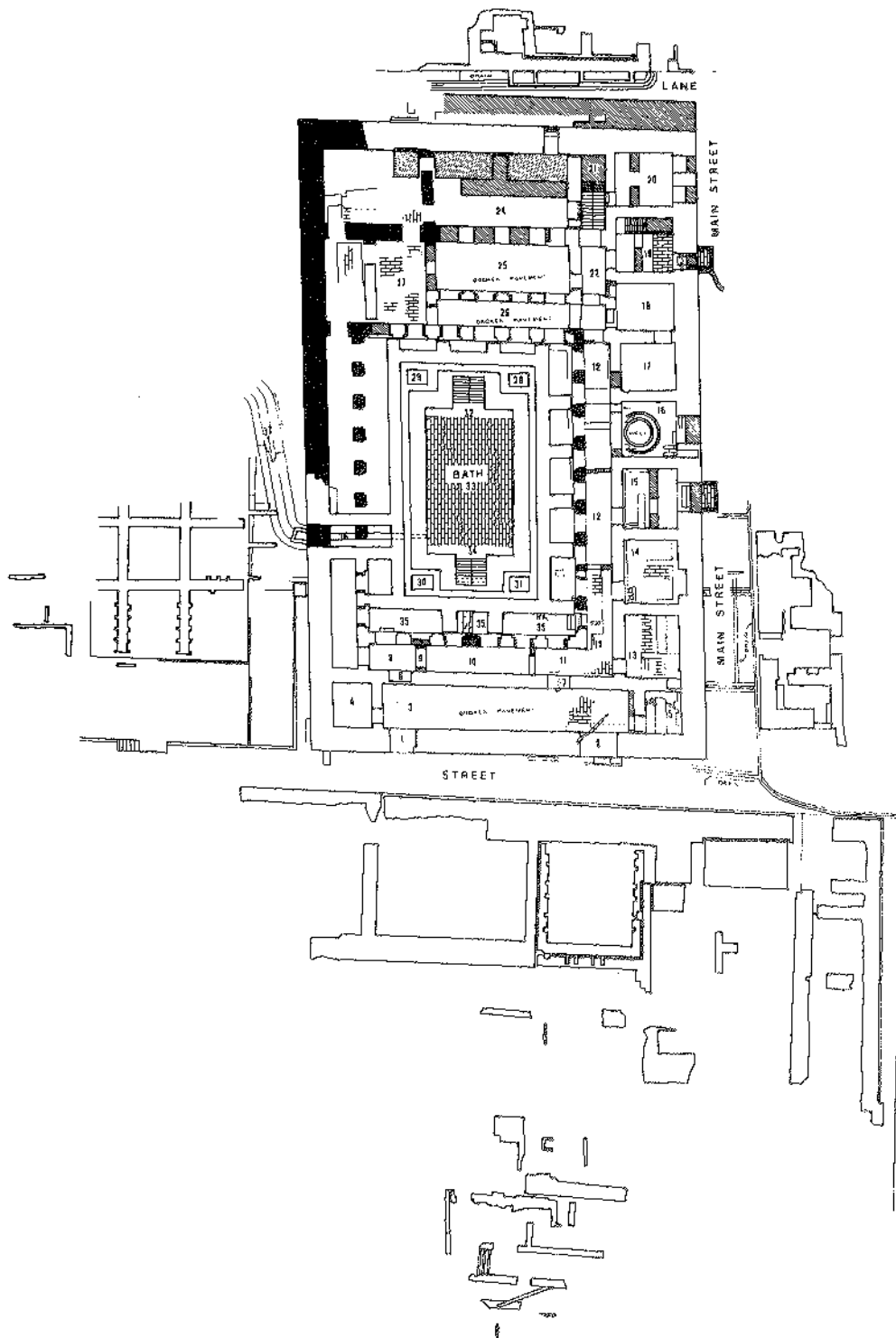


Figure 3 The Great Bath in ground plan.



The centre-piece of the complex was the pool, a sunken rectangular basin measuring approximately 12 × 7m and 2.4m deep. Two opposite flights of ten steps each led down to the basin floor from the narrow ends, north and south, respectively.

The central courtyard with the basin was surrounded by a pillared gallery through which it was entered from the south. The pillars themselves were set two pillar-widths apart. The two main entrances to the complex were in the southern facade and opened onto a narthex-like ante-room from where irregular passageways led on to the pillared gallery, which in turn provided access to the central courtyard and further rooms in the east and north.

Basically, the access system of the complex comprised three concentric approach zones enclosing the central basin. The innermost zone was that immediately surrounding the basin in the central courtyard, the pillared gallery formed the intermediate zone, while the third was the public street round the perimeter. A concentric layout of this kind with a pool as its centre-piece suggests that the approach zones were also designed to serve another purpose, viz. ritual processions.

Having said that, it must be admitted that neither within the complex itself, nor in the pillared hall which originally extended north of the central courtyard, nor anywhere else did any material evidence turn up which could possibly indicate a cult significance for the Great Bath.

The basin was probably supplied with water from a double-walled cylindrical well situated in one of the compartments bounding the pillared gallery on the east. This does not necessarily imply that the basin, with its capacity of 150 cubic metres, was filled by hand, especially since the Harappans were such experienced hydraulic engineers. However, no traces of any kind of filling mechanism could be discovered.

A drain outlet in the south-west corner of the basin allowed the used water to flow out into a mighty brick drain-pipe about 1.8m high which was large enough to walk through and was roofed by a corbelled vault (Pl. 3) The extraordinary height of this drain tunnel may have been necessitated by the difference in level between the floor of the basin and the surface of the public street outside. After running northwards for about 8m the drain shifts to the north-west, cutting across the north-eastern corner of the lower section of the 'granary'. After another 40m it turns north again in order to bypass older buildings which Wheeler mistakenly identified as Late Harappan in 1950.

The construction of the actual basin is a technical masterpiece which testifies to the high standard of Harappan engineering. The 1.35m thick innermost shell, forming the basin side walls and floor, was composed of specially manufactured, carefully uniform bricks pointing inwards and laid so precisely in stretcher bond with gypsum mortar that the joints were only a few millimeters wide. Sandwiched between this inner brick shell and an outer one 3cm thick was a 3cm thick insulation layer of bitumen which the second brick shell prevented from shrinking.

The use of bitumen for sealing water-using structures, familiar in contemporary Mesopotamia, is not testified in the Harappa Culture apart from the Great Bath of Mohenjo-Daro – a unique structure in this and many other respects.

The peripheral substructure of the Great Bath was likewise carefully executed. The double-walled basin was enclosed within an outside wall which also served as the foundations for the pillared gallery and was protected against lateral pressure by the

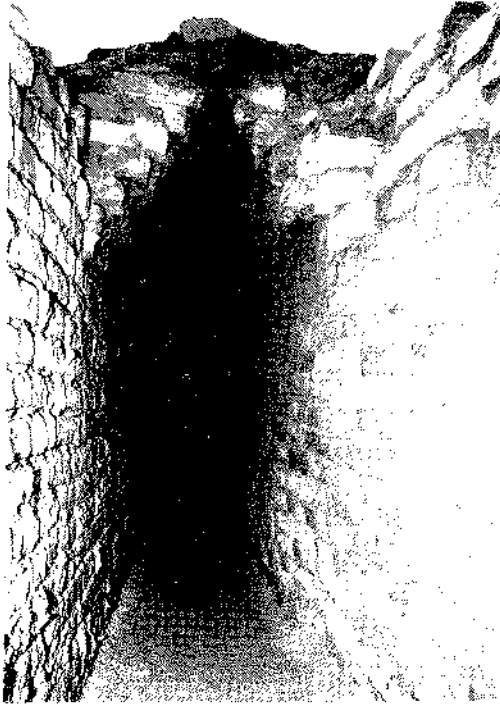


Plate 3 The corbelled drain leading from the Great Bath.



Plate 4 Latrine adjacent to a bathing platform in area HR-B.

insertion of transverse reinforcement walls. This method of construction suggests that the purpose of the buttressed outermost wall was to consolidate the actual foundation pit before the free-standing basin was erected inside it. The intervening foundation pit area was then filled in with stamped clay.

The Great Bath subsequently underwent major alterations. The western and northern sections of the lane round the perimeter were partially blocked, reducing them to narrow passageways. Partition walls were erected in parts of the pillared gallery, making it impossible to walk unhindered round the pool in the shade. North of the basin the pillared hall was bricked up and filled in, creating a raised platform reached via a flight of steps. Clearly the original function of the complex had already been abandoned by this period.

When the Great Bath was excavated in 1925 the entire north-western portion of the outer wall had long since disappeared, likewise most of the western row of gallery pillars. As it stands today, the Great Bath is a hypothetical reconstruction which had already been completed by 1927.

In the uppermost layers of accumulated deposits covering the Great Bath and many other sectors of the city the remains of later building activity were found, together with artefacts from the Harappan period. (A sherd bearing a Brahmi inscription unearthed in the basin itself is in fact a secondary find; cf. Jansen and Zäscke 1983.) Apparently the Great Bath and other large buildings fell out of use in the post-urban phase and

their original functions discontinued, which is a further indication of the progressive deterioration of urban living standards and the accompanying disintegration of the administrative organization of the city. On the other hand, the presence of Harappan artefacts in the uppermost layers implies a certain continuity in the traditional crafts on a local level and hence weighs against the hypothetical sudden abandonment of the settlement. It is too late now to determine whether the destruction of the Great Bath had already taken place in Harappan times or whether the damage was much more recent, e.g. brick-robbing or erosion.

It puts no great strain on the imagination to picture this pool filled with clear water on a summer's day, 50°C in the shade, visitors relaxing in the shady gallery and soaking up the coolness of the evaporating water. Without a doubt, this pool right in the middle of the city was an extravagant luxury.

The Great Bath of Mohenjo-Daro preserves for us the most important water-using structure known from the Bronze Age. Its special significance lies in its representing the first time that, many centuries before its systematic implementation by the Romans, the idea of deliberate extravagance in the use of water within the city took concrete form. However, the fresh water was still obtained from draw wells, i.e. by means of a vertical water supply system, whereas in classical antiquity fresh water was generally supplied by means of aqueducts and underground pipes, i.e. a horizontal system. Yet this does not alter the fact that water was deliberately squandered on a lavish scale in Mohenjo-Daro, as is obvious from the over 700(!) wells which ensured that the bathing facilities in the private dwelling-houses were also kept amply supplied.

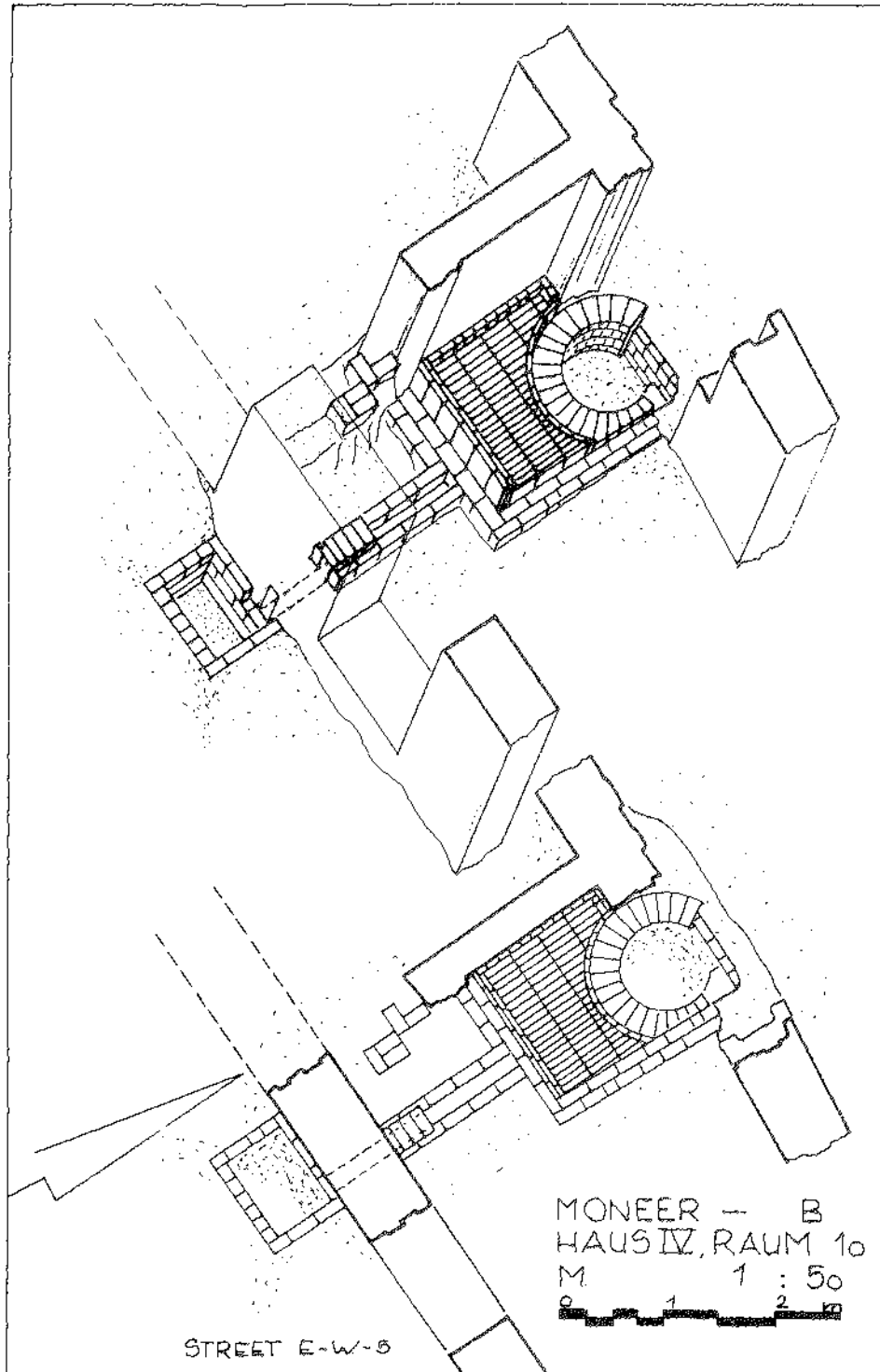
### **Bathing and toilet facilities**

The level of technical accomplishment and sheer frequency of the bathing platforms in Mohenjo-Daro make them unique in the ancient world. Even in Mesopotamia, where the use of a standard-sized brick as the smallest building construction element can be paralleled in the Harappa Culture, such bathing facilities were practically unknown.

A typical bathing platform was installed inside the private house, either as a reserved area within a larger room or as a separate, custom-built 'bathroom', and consisted of a slightly raised platform floor, sloping to allow the used water to drain off, and built of several layers of bricks laid either with the points staggered or in cross bond (Fig. 4). This platform was edged in by a row of standing bricks, forming a shallow basin. In order to keep the clay-filled joints as narrow as possible, the floor bricks were precisely formed with sharp edges. The outside surface of the bricks is deep red in colour and worn almost shiny from frequent use.

In many cases these private bathing platforms were bounded on one side by a short flight of only three or four steps leading up to a small landing approximately 80cm high from which the bather below could be showered down, presumably with buckets of water.

The platform floor generally sloped towards a corner where the effluent was guided either along a gutter or through an outlet in the wall whence it was discharged into the street drain or into a catchment vessel outside. Sometimes the floor sloped downwards



*Figure 4* Bathing platform in house IV room 10.

on either side towards a central outlet in the outside wall. Drainage was simplified by the fact that the bathing platforms were usually situated on the street side of the houses.

A latrine is often incorporated in the outside wall of the bathing platforms, sometimes fitted with its own vertical chute through which the sewage fell either directly into the street drain or into a cesspit (Pl. 4). A larger brick or wooden plank for sitting on was placed across a pair of raised side supports. But latrines of the simple type still widely used in the region today were also found, consisting merely of a hole in the ground above a cesspit.

### **Sewage system**

An astonishing feat of civil engineering achieved by this culture over 4,000 years ago is the network of effluent drains built of brick masonry along the streets of Mohenjo-Daro. The drains mostly ran along past the houses on one side of the normally unpaved streets, some 50 or 60cm below the surface. U-shape in cross-section, the sides and bottom of the drains were built of bricks set in clay mortar while various coverings could be used for the open top. These covers, whether loose bricks, flagstones or wooden boards, could be removed for cleaning as required. The width of the open top depended on the size of the bricks which ranged from  $25 \times 13 \times 5.75\text{cm}$  to  $29.5 \times 14.6 \times 7.6\text{cm}$ . Thus a typical drain cross-section may be 17 to 25cm broad and 15 to 50cm high, i.e. between two and eight brick courses deep. This gives a capacity range of between 260 square centimetres and 1,200 square centimetres.

The drains sloped at a gradient of about 2cm per metre and met at different levels depending on their depth. Curved structures were sited in such a way that frictional loss was cut to a minimum. Wherever a drain had to traverse a longer distance or several drains met, a cesspool was installed, this being the simplest method to avoid clogging by allowing solids to settle. The effluent flowed into the brick shaft at a high level, filled it and flowed out the other side at a slightly lower level. The suspended matter gradually formed a deposit which could be removed via steps leading down into the pit. These cesspools were probably covered over with wooden planks.

Besides the closed sewerage installations for disposing of domestic effluent, open soak pits were also in common use, especially where small lanes opened onto bigger streets. They had to be cleaned of settled deposits from time to time.

In places where the street drain was too far away from the house, closed sewage catchment vessels were used instead. These were positioned under the vertical toilet chute outside the house and had to be tipped out regularly. In some cases they were fixed permanently into the wall so that their contents had to be scooped out. Yet other vessels had perforated bases and worked much the same as soak pits.

### **House connections to the mains**

It was not usual for the houses to be connected to the sewerage system by means of individual house drains, as the bathing and toilet facilities were generally situated on

the street side of the houses where the effluent flowed straight down through a chute into the public drain below or else into a catchment vessel. In many cases, these built-in chutes stopped short some distance above the relevant drain or vessel. In House 49, HR-B Area, for instance, the effluent chute servicing two toilets ends short, which must have caused a penetrating smell.

The presence of these wall chutes proves the original existence of at least one upper storey. Vertical pottery drain-pipes were also found. Consisting of a stack of conical pipe sections each about 60cm long which was built into the outside wall, such a drain-pipe would have drained the roof or an upper floor.

The offensive odours emitted by the sewage chutes, soak pits, cesspools and sewers must have been a considerable public nuisance which could only have been relieved somewhat by a constant high rate of flow and frequent cleaning. Both relief measures would have required a great deal of man power. In particular the maintenance of the drainage system must have been a labour-intensive public burden. This raises the question as to the type of institution which was responsible for this maintenance work and to how it was financed.

#### **The water supply and sewerage systems as indicators of stratigraphic contemporaneity**

We have long been aware that the stratigraphy for Mohenjo-Daro developed by Marshall (1931) and Mackay (1938) is invalid, as it is erroneously based on absolute height measurements rather than on strictly stratigraphic data (Jansen 1984).

Recent studies have shown (Jansen under preparation) that in many parts of the site a revised chronology can be obtained by reconstructing 'drain net units', or groups of houses/structures with interconnecting drains indicating contemporaneity of construction. At least in the case of such interconnected structures contemporaneity can be postulated for their bathing platforms and/or door-sills, even if they are found at different absolute levels, and hence by extension also for the finds recorded in these strata.

The unreliability of absolute height readings as indicators of contemporaneity can be demonstrated in the deep dig in the DK-G Area, where no fewer than three successive phases of drain rebuilding are documented. Not only that, these phases occur at widely differing levels even within this small excavated sector, proving once again that the process of vertical growth was not a unilinear blanket development affecting the entire site at the same even rate, as imagined by the excavators.

This example shows the potential importance of structural features such as drains in an attempt to reconstruct settlement growth patterns, especially at a site so densely built-up as Mohenjo-Daro.

#### **Conclusion**

Even today, the final stage of the development from the 'Early or Pre-Harappan Cultures' to the mature Indus Civilization remains a mystery. However, our criteria for

distinguishing these stages have become markedly more clear-cut.

Besides the script and numerous other features already listed by R. Mughal (1971), the inner-urban water supply and effluent disposal systems stand out as major achievements of the mature Harappans. Here, for the first time in the history of mankind, such waterworks were developed to a perfection which was to remain unsurpassed until the coming of the Romans and the flowering of civil engineering and architecture in classical antiquity, more than 2,000 years later.

The quality of an urban infrastructure such as the water supply and sewerage systems serves as an indicator of the socio-economic structure of the community concerned. Applied to Mohenjo-Daro, the most striking aspect of this infrastructure is the homogeneous distribution of wells and drains and/or soak pits throughout the urban area, apparently independent of social parameters such as house size.

It would be premature to infer a similar homogeneity on the social level, or even certain common elements. Nevertheless, it is worth noting that analyses of artefact distribution patterns have revealed a similar homogeneity of distribution over the whole settlement in the case of specific classes of artefacts, in particular figurines and seals.

Added to these findings, the fact that no indications of a secular or sacral form of absolutist government ever turned up could tempt the modern observer to postulate a social organization based on self-governed 'burghers' in the Indus Valley during the Harappan period. However, there is no known parallel for such a hypothetical system of self-government in other comparable civilizations of the third millennium BC nor, indeed, do we expect to find one that pre-dates the Greek polis of the fifth century BC.

We have to admit that our knowledge of the cultural background of the Indus Civilization is still very meagre, and only continued intense research will provide us with a deeper insight into it. But we can now safely claim that the investigation of an 'unimportant' feature such as the water supply and sewerage systems can not only prove extremely instructive in its own right, but also provide plenty of scope for sociological interpretation.

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## References

- Jansen, M. 1976-7. Mohenjo-Daro - 5000 Jahre Keramik im Kanalbau, I + II. *Steinzeug-Information Ausgabe 24 & 25*, Hrsg.: Fachverband Steinzeugindustrie e.V. Köln.
- Jansen, M. 1979. *Architektur in der Harappakultur. Eine kritische Betrachtung zum umbauten Raum im Indus des 3.-2. Jahrtausend*. Dissertation. Reihe B Antiquitates Orientales Band 2, R. Habelt, Bonn.
- Jansen, M. 1984. Theoretical aspects of structural analyses for Mohenjo-Daro. In Jansen and Urban (eds) 1984a: 39-62.
- Jansen, M. 1985. Mohenjo-Daro, City of the Indus Valley. *Endeavour* (new series) 9 (4): 161-9, Pergamon Press.

- Jansen, M. 1986. *Die Indus-Zivilisation – Wiederentdeckung einer frühen Hochkultur*. Dumont Dokumente 'Archäologie', Köln.
- Jansen, M. 1988. Siedlungswasserwirtschaft in Mohenjo-Daro. *Veröffentlichungen der Frontinus Gesellschaft*.
- Jansen, M. Forthcoming. Mohenjo-Daro: type site of the earliest urbanization process in South Asia. Seven years of research at Mohenjo-Daro, Pakistan, an attempt of a synopsis. *Urban Form and Meaning*. Washington.
- Jansen, M. and Urban, G. (eds). 1984. *Interim Reports vol.1. Reports on Field Work Carried out at Mohenjo-Daro Pakistan 1982–83*. IsMEO-Aachen University Mission, Aachen.
- Jansen, M. and Urban, G. (eds). 1987a. *Interim Reports vol.2. Reports on Fieldwork Carried out at Mohenjo-Daro, Pakistan, 1983–84*. IsMEO-Aachen-University Mission, Aachen.
- Jansen, M. and Urban, G. (eds). 1987b. *Vergessene Städte am Indus. Frühe Kulturen in Pakistan vom 8. bis 2. Jt. Katalog zur Ausstellung*, Mainz.
- Jansen, M. and Urban, G. (eds). Forthcoming. *Site Atlas Mohenjodaro*. (in Vorbereitung)
- Jansen, M. and Zäschke, W. 1983. *Siedlungswasserwirtschaft – eine historische Betrachtung*. Festvortrag auf der Versammlung der Europäischen Vereinigung der Steinzeugröhrenindustrie. September, Interlaken.
- Jansen, M. Fischer, K. and Pieper, J. 1987. *Architektur des Indischen Subkontinents*. wb Darmstadt.
- Mackay, E. J. H. 1938. *Further Excavations at Mohenjo-Daro*. 2 vols. Delhi.
- Marshall, Sir J. 1931. *Mohenjo-Daro and the Indus Civilization*. 3 vols. London.
- Mughal, R. 1971. The Early Harappan period in the Greater Indus Valley and northern Baluchistan (ca. 3000–400 BC). Doctoral dissertation, University of Pennsylvania.
- Strommenger, E. 1980. *Habuba Kabira – Eine Stadt vor 5000 Jahren. Ausgrabungen der Deutschen Orient-Gesellschaft am Euphrat in Habuba Kabira, Syrien*. Mainz.
- Tosi, M. (ed.) 1983. *Prehistoric Sistan I*. IsMEO Rome.

#### Abstract

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#### Water supply and sewage disposal at Mohenjo-Daro

Mohenjo-Daro, a major urban centre of the Indus Civilization, dating to the mid-third millennium BC has produced evidence of a sophisticated system for supplying water and expelling sewage. Water came from more than 700 wells and supplied not only domestic demands but also a system of private baths and a Great Bath for public use. Drains and sewers were carefully constructed to facilitate the removal of waste. The system is described and its social context considered.