Recently Excavated Harappan Site Dholavira

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[Being one among the five largest Harappan cities in the subcontinent, Dholavira has yielded many firsts in respect of Indus civilization. Fourteen field seasons of excavation through an enormous deposit caused by the successive settlements at the site for over 1500 years during all through the 3rd millennium BCE and unto the middle of the 2nd millennium BCE have revealed seven significant cultural stages documenting the rise and fall of the Indus civilization in addition to bringing to light a major, a model city which is remarkable for its exquisite planning, monumental structures, aesthetic architecture, amazing water harvesting system and a variety in funerary architecture. It also enjoys the unique distinction of yielding an inscription made up of ten large-sized signs of the Indus script and, not less in importance, is the other find of a fragment of a large slab engraved with three large signs. This paper attempts to give an account of hydro-engineering that is manifest in the structures of the Harappans at Dholavira.]

The ancient site at Dholavira (23^0 53' 10" N; 70^0 13'E), Taluka Bhachau, district Kachchh in Gujarat, lies in the north-western area of the island of Khadir which is strongly isolated by the cheerless and barren salt waste of the Great Rann of Kachchh. Lying to the north of the village, the ancient settlement is embraced by two storm-water tunnels, namely, the Manhar in the south and Mansar in the north (fig. 1). Originating in the low chain of the hills running along the northern edge of the both descend through a short course into the Rann in the west. The ruins, including the cemetery i.e. half-way down the slope are spread over an area of about 100 hectares half of which was appropriated by the articulately fortified settlement of the Harappans alone.

The salient components of the full-grown cityscape consisted of a bipartite 'citadel', a 'middle town' and a 'lower town', two 'stadia'- one wide and extensive, the other much smaller and compact- an 'annexe', a series of reservoirs- all of them set within enormous fortification running on all four sides. The city was perhaps configured like a large parallelogram boldly outlined by massive walls with its longer axis being from the east to west. On both sides of the city-wall, there was provision

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of a broad road running all around. On the bases of their relative location, planning, defences and architecture, the three principal divisions are designed tentatively as 'citadel', 'middle town', and 'lower town', which temptingly sound analogous respectively to three interesting terms in the Ṛgveda viz., *'parama' 'madhyama'* and *'avama';* (which are used in all three genders as adjectives or nouns denoting three different categories of zones, regions, stations, even settlements or building, whether divine, ethereal, terrestrial or human).

The citadel at Dholavira, unlike its counterparts at Mohenjodaro, Harappa and Kalibangan, was laid out in the south of the city area. Like Kalibangan and Surkotada it had two conjoined subdivisions, tentatively christened as 'castle' and 'bailey', located on the east and west respectively, both are fortified ones. The former is the most zealously guarded by impregnable defences and aesthetically furnished with impressive gates, towers and salients while the latter is lower in height and enclosed by comparatively less thick walls. To the north of the citadel was provided a broad and long ground which may have been put to multiple purposes such as for community gathering on festive or special occasions, a stadium and a marketing place for exchanging merchandise during trading seasons (s). Further north, there was laid out the enwalled middle town, and to the east of it was founded the lower town. The last-mentioned one did not have an appurtenant fortification though, it was set within the general circumambulation running around the entire city. These three major built-up divisions made together an L - shaped design : the citadel and the middle town forming the shorter line from the south-north and the middle town and the lower town forming the larger stroke along the west-east axis.

Besides to the south of the castle, across the adjoining reservoir, there was raised another built-up area running along the city wall. It should, as it appears have been an annexe meant for housing the retainers and menials attending on the privileged occupants of the castle of a warehouse.

The layout that is briefly described above pertained to the fully-developed form of the Harappan city, its culture as well as urbanization. There are identified seven major cultural stages signifying gradual rise, culmination and fall of the Urban System of the Harappan civilization vis-a-vis the settlement. This sequence in its entirety is best documented in the occupational debris lying stratified in the castle which alone witnessed all the vicissitudes spread over a time period of one and a half millenniums.

The total artificial accumulation works out to about 15 m out of which only 11.30 m accounted for regular occupation, while the remaining ne goes with the one-time raising of 2 m in addition to the higher ridges of the defensive walls.

The first settlement that was raised at the site in Stage I was a strong fortress now lying buried in the citadel mound. A part of the southern arm of its fortification, running along the east-west axis, was laid bare near the south-western cornet where its basal width measured 11.10 m from where the wall with tapering sides rose to the extant height 4 m. It yet showed sign of further rising. This fortification perhaps covered a somewhat larger area, particularly in the east, where remains of a massive wall of identical nature and orientation has been found running further eastward beyond the south-eastern corner tower of a later date.

The foundation of the planning that was laid in Stage I formed the nucleus on which the subsequent settlements of the later stages expanded gradually. Even the building materials, whether standardized bricks (9 × 8 × 36 cm, ratio 1 : 2 : 4) or stone, both undressed and dressed remained in use.

In Stage II, a 2.80 m thick brick masonry wall was added to the pre-existing defensive wall from the inner side and the face of it was plastered over with fine paste of white and pink clays at least as many as thirteen times. There is another significant development that took place. A residential area was corning up to the north of the walled settlement. Besides, pottery forms and antiquities diversified as well as increased in both quality and quantity.

Stage III was a most creative and important one in many respects: the southern arm of the antecedent fort-wall was further widened from the inner side with an additional brick-masonry of about 4.5 m and the existing walled settlements was made into a castle and another walled subdivision, arbitrarily called as bailey, was added to it from the west. In the north, the extended residential area of Stage II was cleared of structures for carving out a multipurpose ground. Further north, the extensive walled town (which would become middle town subsequently) was founded. Reservoirs were created on the south, west and north of the built-up divisions. And, finally, an outer fortification in order to surround all those components was constructed during this stage. For the first time, three steatite seals with figures but without inscriptions appeared in addition to a potsherd bearing Indus signs and a cubical weight. Besides, a good number of classical Hrappan pottery forms with painted motifs made their debut.

When the town of Stage III had lived two-thirds of its life, it was immensely damaged by a natural catastrophe, most possibly by an earthquake of intense magnitude, its tell-tale marks are distinctly present in the defensive wall of the castle. Repairs were undertaken and lower town was added and the city-walls were extended further eastwards in order to enclose as well the newly found division of the settlement. As a result, the erstwhile town attained full cityscape that dominated the cultural scenario for centuries through Stage IV and V. In Stage III itself, certain more qualitative changes took place, as if under new dictates for planning, so as to obtain fresh prescribed ratios and proportions within each as well as amongst different divisions of the enlarged city. It shall be dealt with later on. Likewise, it brought about some modifications and alterations practically in each of the earlier division and subdivision of the settlement.

It is significant to note here that during the first three stages, i.e. I, II and III, the inhabitants exhibited an abiding preference for colourful clays. e.g., white and pink structures such defensive walls, roads, streets or the ceremonial ground, or to the walls and floors of private houses. In this situation, we may infer that even roof tops of house were also being treated similarly. But, this tradition came to an abrupt end with the end of Stage III, as if under a royal decree or by a resolute public consensus. In this case, we are tempted to think loudly that there came about a drastic, rather an almost revolutionary or reactionary change verging on political, social or religious fervour or commotion. We would soon witness more changes coming close on the heels. However, before that, the cityscape had attained its fullest growth.

Stage IV belongs to the classical Harappan culture which is so widely familiar with a large number of excavated sites. Almost all the salient features of the city planning were scrupulously maintained along with the monumental structures such as gateways, fortification, drainage-system. Those elegant pillar members as well as freestanding columns were the creations of this stage or that of the preceding one. The famous ten-signed inscription was surely in use in this stage. All the classical Harappan elements such as pottery, seals, weights, beads, items of gold, silver, copper, ivory, shell, faience, steatite, clay and stones are found in abundance.

Stage V is characterized by the general decline particularly in the maintenance of the city. It is more vividly reflected in the citadel. The other items such as pottery, seals, weights, etc., continued in use.

This stage was followed by a temporary desertion of the site, perhaps not lasting more than a few decades before the Stage VI ushered in.

Stage VI presents a state of transformed Harappa culture which is so widely distributed in Gujarat. New ceramic traditions coming from the sites of Sind, Rajasthan and other parts of Gujarat made appearance. The one-time city shrank into a smaller town which became confined to the citadel and the southern margin of the middle town where they delimited it by raising a wall of an entirely different workmanship. The classical planning was largely given a go-by. Only the fortification of the castle, the bailey, and partly that of the middle town and partly of the city, which were still standing with their gates, were appropriated for use. Domestic buildings were laid out in a different planning. And, those were, by and large, rickety and jerry-built. Bricks were no longer in use. While many of the pottery forms together with distinct decorative motifs were still in vogue, the fabric had certainly underwent a perceptible change. In addition, new ceramics in the form of white painted black-and-red and white painted grey wares along with a coarse ware bearing incised or applique or both kinds of designs made their appearance. Many other traditional items continued in use though the seals underwent a change. Rather being square in form, those were long rectangular with a flat or triangular back. Those still bore nicely cut inscriptions only and no figures. Their shapes always became smaller and simpler. Stone cubical weights were still in vogue in addition to those out of potsherds. Overall picture that is projected is that impoverishment and rapidly crumbling urbanism. Having lived there for about a century, the late Harappans of Stage VI abandoned the settlement.

The desertion that followed was certainly a longer one. How long? It is not certain at present. The newcomers of Stage VII had forgotten the classical Harappan fabrics, shapes and designs. Strangely enough, the newcomers built their houses in an entirely new form that was circular. No planing as such is discernible. All the urban attributes became conspicuous by their absence.

Thus the urbanization that made its humble beginnings in stage I and went on progressing through Stages II, III and IV, started decaying in Stage V and underwent a transformation in Stage VI with a feeble revival only to become totally deurbanized in Stage VII. The site was never occupied thereafter.

Lying in between the storm-channels and half-way down between the hills and the Rann, the site with a few rocky protuberances and ridges and naturally deposited sediments was ideally suited for a settlement having fortifications, built-up areas and

artificial dames and reservoirs. The fortification walls, both inner and outer, were in fact solid structures made of proportionately moulded mudbricks set in mud mortar. Successive courses of brick-work were laid in a recessed manner. As a result, both the faces registered a marked taper, while the outer faces of the inner ones where plastered with clay. Only in the event of repairs or where the walls of bastions were susceptible to erosion the builders resorted to stone facing.

The outer wall which was constructed in Stage III and remained in use throughout Stage IV and V and partly during Stage VI runs for a length of 781 m along the east-west axis on the north and 630.50 m along the north south on the west. The southern arm is traceable for a distance of about 600 m and the eastern one for 210 m with a vague indication for another 100 m. in the east, the ground being higher and more vulnerable to surface water and wind action, the eastern wall and half the northern wall had suffered considerably to the extent of being obliterated for stretches. In the south-eastern quarter, particularly across the Manhar *nallah,* the wall, if existed at all, is not traceable now. Another, interesting feature is the provision of projection salients almost at regular intervals. Depending on the presence of vaguely to fairly observable remains there were provided, excluding the corner towers, 11 salients along the northern and 9 ones along the western arm of the city-wall, roughly at a distance of 50 to 52 m. Similarly, salients can be seen along the extant segments of the other arms too.

Likewise, there were 5 salients along the northern and 4 along the western arms of the middle town. Barring a smaller one in the south, no other gateways piercing through the outer walls has so far been exposed although there are certain prospective points. Of course, one gate provided in the east end of the middle town is laid bare while a few others are suspected in the other arms as well. In the castle, there was provided an impressive gate somewhere in the middle of each arm, although in the eastern wall a wide opening furnished with a flight of broad steps going down thickness of the defensive wall in addition to a regular gate. But, surprisingly, the steps in this gate under reference stopped on the outer edge of the wall and never descended onto the lower ground level on the east-thus rendering its function indeterminate.

The city of Dholavira in its fullest form was a precisely proportionate whole and proportionality resolved configuration following a resolute set of principles of planning and architecture with mathematical precision and perhaps with astronomically established orientation. Of the city, at present, three corners with partially eroded

towers but fully intact inner corners are fairly traceable and thus confirmed by excavation. Those are lying in the north-east, the north-west and the southwest. They together have provided the northern and the western anus of the outer fortification. When measured on the ground from the inner corners to the corresponding inner corners, the E-W length along the northern defensive wall and N-S one along the western one worked out to 771.10 m and 616.87 m, respectively-thus giving the precise ratio of 5 : 4. Similarly, the other divisions of the city also revealed amazing ratios and proportions which rather provided in all other major and minor entities of planning and architecture. However, in the following table only some principle features are taken into account :

Sl. No.	Division	Width	Length	Ratio
1.	City, internal	616.87	711.10	4 : 5
2.	Castle, internal at available top	92	114	4 : 5
3.	Castle, external as per present exposure	118	151	4 : 5
4.	Citadel (castle + bailey), external approximately (including bastions)	140	280	1 : 2
5.	Bailey, internal	120	120	1 : 1
6.	Middle Town + Stadium internal	290.45	340.5	6 : 7
7.	Middle Town, excluding Stadium internal	242	350.5	5 : 7
8.	Stadium, internal	47.5	283	1 : 6
9.	Lower Town, built-up area	300	300	1 : 1

We have seen the precisely proportional relationship between the castle and the city. It should be worthwhile to find out whether there existed a similar inter-relationship in terms of locational disposition as well. It did indeed. The diagonal drawn between the two opposite angles made by the north-eastern and the south-western corners of the city touched the north-western corner of the castle. Of the remaining two, the south-eastern corner is still missing, or not found out. Therefore, a line bisecting the angle of the remaining city corner in the north-west into two equal halves

was extended towards the south-east. Surprisingly, this line not only bisected the angle of the corresponding north-western corner of the middle town and further on cut across a crossing of major streets in the same division but also struck the north-eastern corner of the castle. This could have been achieved by mathematical calculations and drawings. In the whole scheme, the enwalled area of the castle became 49^{th} (7×7) part of that city and total built-up area of the former 25^{th} (5×5) part.

The two third of the middle town was laid out with three bold projections and two recesses provided on either side of the arterial street running from east to west. It can be better visualized if one recalls the indented ground plan of a developed Indian temple having projections and recesses on all four sides. In the middle town, there are seen two full and one half such units of which the slightly smaller one is in the western part, larger one in the middle and the half on the east where the last-mentioned one is bounded by the inner peripheral street that runs along the eastern defensive wall of the town. Another significant feature is the arterial street that run across axially from west to east dividing all the abovementioned units and sub-unit into two equal halves, and a north-south street, perhaps somewhat staggered, further subdivided each unit: Thus, rendering each unit having four built-up areas subdivided by streets. This kind of layout of the town helped carve out six open spaces in between the surrounding fortification walls and the built-up areas. However, on the southern margin of the town the resolution seems to have been entirely different in that there was a straight, continuous and rectangular built-up area running from one end to the other between the bounding fortification walls running along on the eastern and the western sides. This built-up area was also subdivided by a street into two equal halves along the east-west axis. These observations are based on the meager excavation in proportion to the wide expanse of the middle town. Indications are also available to state that each bold projection of a unit might be having likewise a series of minor projections and recesses in each case.

More or less in a similar way, rather in a little more complicated fashion, the lower town too was resolved into several units. That network of units still remains to be studied. Each unit seems to be having likewise projections and recesses and in turn demarcating an open space, of course. The arterial street of the middle town passed through a gate in eastern fortification wall and then went on running across the lower town albeit with a few turns, each at the end of a residential sector. The street however

remained uninterrupted. Other major and minor streets and a lane shot off from the axial street for making a defined network of housing sectors.

The kind of efficient system that the Harappans of Dholavira developed for utmost conservation harvesting and storage of water speaks eloquently for their advanced hydraulic engineering given the state of technology in the third millennium B. C. E. This concern for water also tells for the contemporary environment which may not have been glaringly different from what prevails now. The water must have been a precious commodity as of now. Seated on the margin of the monsoon belt, Kachchh experiences poor, often erratic summer precipitation. Failure of monsoon, sometimes for consecutive years, is quite a phenomenon. There are no perennial rivers, lakes or springs. The ground water is, by and large, brackish and saline and unfit for human and animal consumption and even for cultivation largely. The winter rainfall is almost absent. Therefore, droughts are frequent and so are famines. On the whole, the environment is harsh and hostile to human existence. In such a rid Kachchh, the Khadir Island where Dholavira lies is the second poorest in rainfall which only averages to 262 mm per annum.

A good deal of forethought must have gone into selecting the site even for the first settlement which was by far a fortalice only. The early Harappan chose a higher ground by the side of the Manhar, one can see that an (or rather the) inundation channel, if not the main channel itself, was flowing in the east and then running along the south of the site of the first settlement. The first settlers who had developed expertise in Baluchistan and Sindhi Kohistan before coming to Kachchh may have successfully dammed the Manhar and deepened its bed by cutting the basal rock in order to carve out a large reservoir spreading over in the east as well as the south of their fortress. Perhaps, the aberrantly cut deep tank, a lower part of what can seen inside the subsequent rock-cut reservoir to the south of the castle, if the remnant of the first experiment. Surely, the selection of such a site beside a smaller torrent having potential of being tamed was a well-considered decision.

Otherwise, there were existing many a deeper and broader channels having voluminous flood regime but those were certainly too difficult for harvesting water as the builders did not posses the knowledge of raising durable dams for want of dependable cementing material. This choice of site naturally suited well to all the successive Harappans who gradually developed it into a town and then a city. Given a slopping nature of a wider ingeniously encompassed all the principal divisions of

the expanded settlement. In order to harvest more water, they reached out to the Mansar which too was dammed for filling the reservoirs. In fact, the Manhar has evidenced for three and the Mansar for two places where the dams were raised across their channels. At the prospective site of the lowermost dam thrown across the Manhar there were exosed lower remnants of several closely adjoining parallel walls in the river - bed by simply removing the sand accumulated over them. Nearby and further down-stream, a scatter of huge stone blocks of different geological formations other than those found in the vicinity may be seen lying helter-skelter in the bed. Those blocks, some of them cut to size, are too heavy for being transported over distance by the flood waters of the channel. Similar situation prevails at the other dam sites too. Close to the lowermost dam site across the Manhar, an enormous bounding wall with a neatly plastered face and having an inlet channel higher up for letting surplus of the dammed-up water into the southern series of the reservoirs was laid bare. The deposit accumulated on the other side of the inlet channel vividly showed the angle and depth of fall as well as the force of water.

In all fourteen gates, some elaborate and some simple, have been laid bare in different divisions and area of the Harappan city of Dholavira. The breakup is : Castle 5; Bailey 2; Stadium 4; Middle Town 1 and Annexe 2; and none so far is the lower town.

The Castle was found provided with five gates pierced through the fortification. Each one has revealed a distinct design. While the eastern arm has yielded two gates, there was one in each of the remaining three walls. The south gate has a concealed passageway with an ordinary doorway at its southern end where it was connected to a flight of wide steps descending to the northern embankment of the rock-cut reservoir. As already stated, it was in use during Stage III but was sealed off something in the following stage of Stage V.

The West gate which afforded intercommunication with the bailey was in the form of a 9 m long and 2.2 m wide passage way with a small guard room carved in the southern wall while the northern side was found washed away completely to the floor level of the passage. The sloping passage way has a few steps at the outer end which was provided with the steps made of large limestone slabs one of which may be seen as a plano-convex with rounded sides placed as the lowermost steps as of now.

The East Gate one of the two principal ones, had a large chamber consisting of an elevated side-chamber on the south and a collateral sunken passageway on the

North (fig. 2). The passageway was connected to a flight of 14 steps at the inner end while it was fitted with a doorsill made of large limestones slabs at the outer one. At both the ends, it must be having huge doors. At either end on top of the side wall of the elevated side chambers, there was found a set of nicely cut and smoothened limestone block of rectangular shape. The topmost block bore two long sockets one each on two sides and parallel to each other. As evidence had it, each set of the blocks was the base for a pilaster, made of mud concrete bricks, and built to the ceiling of the gate chamber (fig. 3). Each pilaster was probably veneered with a wooden casing which was closed fit by a grooved and tongued joint into the couple of sockets. In the centre of the side wall was found another limestone block supporting a beautifully carved and polished pillar base having a pronounced concave profile and straight sided bottom and top surfaces were flat. The top surface bore in the centre a 5 mm circular hole. By the side of it, two large-sized pillar members with rounded sides and flattened top and bottom were found lying dislodged. Each flat surface of both the members also showed a similar hole for receiving a dowel. In front of the gate, there was exposed a high terrace raised between two massive flanking bastions. The provision for access made in the form of jerry-built set of steps at the southern side of terrace was a creation of Stage VI while the original approach seems to be lying still concealed under the late Harappan structures. It must be added that, during Stage V, a number of domestic/ industrial buildings were raised on the terrace of the gate.

The East Gate 2 is provided with a series of broad steps going down from the top but terminating higher up on the outer edge of the defensive wall without yielding any evidence of descending to the ground level on the east.

The North Gate was found to be the most majestic, most elaborately designed architectural construction which commanded over the stadium, the middle town, the lower town and further beyond the picturesque landscape (fig. 4). In the thickness of the wall, it consisted of two elevated chambers flanking a sunken passageway which, in turn, was furnished at the inner end with a limestone doorsill flanked by a set of limestone blocks each bearing pilasters sockets on two sides—thereby suggesting the existence of two enormous columns (made of stone masonry) encased by wooden panels.

Those columns may have supported the heavy door frame fitted with two door leaves. A similar provision seems to have been made as well at the outer end of the passage ways evidenced by the door sill with a limestone block bearing sockets at

one end, while the other one was replaced with ordinary blocks at a later time. As the east gate had marvelous bases of a central pillar and two pilasters on the elevated chambers of the north gate as well, although not found intact due to the vandalism wrought by the late Harappans of Stage VI. Similarly there was a 12 m wide and perhaps 33 m broad and 5.6 m high front terrace majestically overlooking the stadium.

On the east and along the high fortification wall, the terrace was connected with a 9 m wide 'ceremonial' pathway descending onto the stadium or 'ceremonial ground' through a gate wide as much. It was, however, reduced in width in Stage V or VI. At the inner end of the passage way of the north gate there was an L shaped staircase having 10 steps, a landing and then another flight of 13 steps turning at a right angle towards the west. Barring the southern one, the other three gates remained in use from Stage III to Stage VI although the last occupants neither maintained them well nor spared them from misuse.

The north bailey gate was constructed under the shadow of the towering north-western corner of the castle. A flight of steps gave access to 7.30 m long and 2.30 m to 2.55 m wide passage way which too was flanked by chambers. It facilitated intercommunication between the bailey and the stadium.

The south bailey gate was likewise built under the shadow of the south western corner of the castle. Further details of the gate are yet to be collected by further excavation.

The east gate of the stadium was also an impressive construction with a guard room on the southern side and a sentry post set in the northern wall. The passageway measured 12.20 m long and 3.80 m broad. The west gate as a simple opening was to provide movement between the two stadia. The east gate of the middle town was flanked by two bastons. Originally, it was comprising two flanking chambers which were got filled up with stones subsequently. At its outer end, there were fitted stone slabs across the width. Those slabs bore two set of grooves perhaps for receiving tongs of some sorts of wooden planks for closing the gate.

The south gate through the city wall provided access to annexe and the rock cut reservoir towards the outside it, however, opened on to a large enwalled area attached to the city wall from the southern side. The subjoined area perhaps housed the state animal farm. Another gate in the annexe area was laid bare in the western bounding wall which lies N - S, joining the city wall with the citadel wall.

Another gate not yet fully exosed stood to provide movement between the

smaller stadium and the reservoir area lying to the east of the castle. Yet another gate uncovered this year offered approach to the stadium as well as to the settlement of Stage VI.

The earliest and the largest stadium found so far perhaps accredited to the Harappans. Lying between the citadel and the middle town, it measured about 283 m E W and 45 m to 47.50 m N S. Almost on all sides, excepting the stretch of a 80 m appropriated by the north gate and the appurtenant ceremonial pathway, it was provided with stands for seating of spectators. The broadest one, 12 m wide, having three or rather four continuously running tiers or terraces, in ascending order, was made abutting the defensive walls of the castle and the bailey. Steps for seating have been seen also atop the enormous defensive wall that stood to the east of the stadium. A similar arrangement of steps is emerging at the west end too. The stand that lay along the middle town or on side of smaller stadium did not show the stepped construction due to perhaps the erosion of the centuries.

The smaller stadium lay under the shadow of the preeminent castle. It was created in the area that was extending from the north-western corner and the east gate 2 of the castle. It was provided with two gates: one for inner communicating with the larger stadium and the other with the eastern outfield and the reservoir area lying extending to the east of the castle. As held before, those stadia which were multi-purpose grounds perhaps are altogether new features of the Harappan planning as well as architecture.

The Harappans during their hey day, created within the city walls in all sixteen for more reservoirs of varying sizes and arranged them, along the northern and western and largely along the southern sides of the main settlement and to the east of the citadel. A gradient of 13 m lying between the higher north-east and the lower southwest was ideally suited in selected tanks instead of letting it spread out over larger area as a thin sheet which should be highly susceptible to quick evaporation and seepage. Many of the reservoirs might not be meant for storing water all the year round as they were carved out by removing the top soil down to the bed-rock which does not behave evenly nor lies adequately deep allover. Possibly, to get all the reservoirs filled with water might have served multiple purposes: first, to utilize the water for large scale repairs to private houses and public structures as soon as the rainy season was over; secondly for the irrigating summer crops; and last, if not the least, to enrich the ground water reserve.

In the whole scheme, the city walls, particularly on the west and its adjoining quarters, played a crucial role. Apart from providing formidable protection to the city, they functioned as strong bunds made of millions of moulded mud-bricks carefully laid in mud mortar. The inner peripheral road lined with stone masonry saved the walls from the water scoring as well.

A tentative estimate indicates that the reservoirs account for about 10 hectares, working out approximately to 10% of the total area covered under the city. Our earlier view that the north-eastern quarter across the Manhar housed a large reservoir was not substantiated by the sporadic digs that were made there.

Recent excavation has brought to light to excellent examples of reservoirs. The eastern reservoir is the largest, grandest and best-furnished one in the series that Dholavira has yielded so far. It was carved out under the shadow of the imposing castle that stands 20 to 22 m west while it is bounded by the little stadium on the north. Now, all of its four corners stand duly ascertained and fully exposed. All the four walls of the basin bear outward slope from the bottom upward. Running north-south, parallel to the eastern arm of the castle wall, the longer axis of the reservoir measuring 73.40 m to 73.50 m at the extant top and approximately 70 m at the bottom and the width at the top and the bottom are 29.30 m and 27.70 m to 27.75 m respectively, while the general depth does 7.50 m to 7.20 m from the mean surface level of the modern cultivated field. Perhaps, the height of the stone-made side wall of the reservoir should have been 7 m to 7.50 m including the 1.00 m to 1.20 m high embankment made of rubble. The ratio in respect of depth, width and length works out to 1:4:10, while that between the length and the width, whether upper of lower, is 2:5. In other words, the length was two-and-a-half times the width and the depth was $1/10^{th}$ of the length, in other words it was $1/4^{th}$ of the width. It is significant to note that the maximum depth that was obtained by cutting the rock has measured to be 10.60 m in the northern part of the reservoir where probing is done limitedly. Not unlikely that the greater part of the reservoir in its central zone was deepened to the said depth of 10.60 m while the margins along all four sides were kept higher having two levels. In its present form the reservoir may be a creation of Stage IV itself. There are, however, indications that the earlier ones, albeit of lesser pretensions in terms of size, shape and depth may have been there perhaps all the time right from the beginning of the first settlement itself. There was surely one during Stage III. Among the other components of the eastern reservoir, the most significant ones are: the three flights of

steps; a rock cut well within a walled enclosure; the smaller and deeper basin cut out of the rock; some other enigmatic and minor features which may have been introduced at different points of time for some special short-lived uses.

In the cultivated fields lying between the castle on the north and the annexe and the city wall on the south, there were buried a series of five reservoirs. These are of varying sizes and orientations excavated into the soft sedimentary formation of sandy limestone. The reservoirs were not arranged in a straight line precisely. Their disposition is rather staggered and can be divided into three sub-units: The first two reservoirs from the east are designated as Southern Reservoirs 1 and 2 (SR-1 and SR-2 in abbreviated forms respectively), the third one consisting of another two reservoirs in the west SR-4 and SR-5 and the second subunit, i.e., SR-3 occupies the central location between the two subunits and was the first to come to light, and, also, perhaps to have been excavated first among the southern ones.

The first reservoir internally measures 30.35 m E-W and 13.90 m N-S with a depth varying in general from 3.90 to 4.20 m while the second is 9.60 m N-S and 4.45 m E-W.

The third one which is centrally located is primarily a rock-cut architecture of excellence, exquisite beauty and superb skill (fig. 5). The excavation has revealed that it consisted of some underground features and some overground appurtenances. Among the former, there are: a deep basin, a deeper trough, a free-board, two masonry flights of steps and a covered rock cut outlet channel. In the later category there are: an enclosure wall and an outlying working platform, a massive levee with inlet drains, a passageway flanked by walls, an ascending flight of steps leading to a covered passageway that was pierced through the defensive wall of the castle. Running almost parallel to the defensive walls of the castle as well as the city, the rock cut reservoir was outlined into a rectangle measuring 33.40 m east-west and 8.90 m to 9.45 m north-south while its bottom had two different levels: the lower one at the depth of 7.90 m from the ancient working surface (8.36 m below from the presently prevailing one); and the upper being at 5.90 m to 6.50 m. In fact, the deeper level pertains to the through that was cut into the eastern half of the basin of the reservoir. It has measured 15.50 m long and 5.65 m broad but oriented, most significantly, oblique to the sides of the main basin at a deviation of 14^0.

The remaining two were oriented somewhat differently from the rest of the reservoirs while both are rock-cut ones. The east-west length of the fourth reservoir's

northern wall measures 11.40 m while its southern counterpart is about a metre less, say 10.34 m. On the eastern-side the width measures 7.10 m, whereas on the west, it is 7.10 m, whereas on the west, it is 7.95 m.

The fifth reservoir measured 16.35 m along east-west on the south and 11.10 m north-south along the eastern side, was largely and, perhaps, intentionally left unfinished with an end-to-end meandering depression along its southern side. The shallower part of the reservoir measured 3.40 m and deeper area went down to 3.40 m.

The citadel has yielded an interesting network of drains, small and large, coming from different directions and ultimately connected to an arterial drain that runs under the broadway which, in turn, divides the walled area into two roughly equal halves. The larger drains are high and broad enough to allow a person to walk through them easily (fig. 6). Usually, all those drains contained fresh water deposits, not sewage or household waste, nor were those connected to any house drains, excepting during late Stage V and all through Stage VI when the former had already become defunct. The purpose of these drains was surely to collect and let out the monsoon run-off. Which is why those are found furnished with air ducts at short intervals. The ducts may have served the purpose of water release as well as manholes.

In the south-western quarter of the castle, there have been laid bare one well, two water tanks, connecting drains and some ancillary structures which together make an integrated complex. The complex has set an example of a kind in the Harappan planning. On the north, it was bounded by the broadway, on the south and the west by the elevated pathways running along attached with the respective fortification walls and, on the east, perhaps, by the residential houses which yet remain to be probed fully and decisively. The well, perhaps, the largest one found so far in the Harappan context, has its internal diameter of 4.25 m across north-south and 4 m east-west. The two tanks fed by the water drawn from the well and conducted through drains are situated close by the well. The larger of the two lies 9 m north and the smaller one 13.20 m north-north-east. Lying 4.70 m apart and placed parallel to each other, both the tanks were connected to the broadway through their respective stairways. Internally, the larger tank measured 4.65 m north-south, 3.15 m east-west and 4.80 m deep. The walls, each 70 cm wide, enclosed the tank. The stairway having six steps measured 2.25 m north-south in length. The steps having a span of 1 m, treads of 40 to 50 cm and risers from 20 to 40 cm, descended only halfway down from the broadway and

terminated 1.90 m above the floor of the tank. The smaller tank measures 2.20 m north-south; 2.30 m east-west; 4.85 m deep; and the staircase being 5.30 m long north-south and 2.45 m wide east-west. The staircase has 14 steps descending from the broadway towards the south. The limestone slabs were used for lining in the present lower margin in both the tanks. The said lining in case of both the tanks pertain to the original construction, while the rubble wall above them are later additions made in order to cope with the rising sediments all around.

Like many amazing elements that Dholavira has yielded in respect of Indus civilization, another aspect is sepulchral architecture. The cemetery lies to the west of the city and covers a very large area. There are found a variety of cenotaphs which include regular rectangular and circular structures. So far as orientation is concerned, besides north-south, or northeast-southwest oriented structures, there are many which are east-west in longer axis which is certainly not Harappan in character. The most interesting are seven hemispherical constructions two of which were subjected to excavations. These were huge mud brick structures, having a circular plan and hemispherical elevation. While one was designed in the form of a spoked wheel, the other was without spokes. Both the structures were made over rock-cut chambers of large dimensions. Primarily, all sepulchral structures are devoid of skeletons although in most cases, they are furnished with grave gods mainly in the form of pottery. One of the hemispherical structures which has been exposed much, has yielded a necklace of steatite beads strung in a copper wire with a hook at either end, a gold bangle, beads in gold foil and other breads, besides specially made pottery. The hemispherical structures remind one of early Buddhist stupas. The kind of design that is of spoked wheel and unspoked wheel also remind one of the *Sera-rata-cakra-citi* and *sapradhi-rata-cakra-citi* mentioned in the : *Śatapatha Brāhmaṇa* and *Śulba-sūtras.*

However, there is a solitary example of a grave with skeleton, with a copper mirror in it.

Among smaller graves, there are cists, or cist in a cairn circle, or a circle or half-circle containing number of grave structures. Surely, the Harappans had a composite society having different ethnic / tribal communities following their own practices.

Dholavira has indeed added new dimensions to personality of Indus civilization and hold promise of yielding more, if given more exposure sometime in the future.

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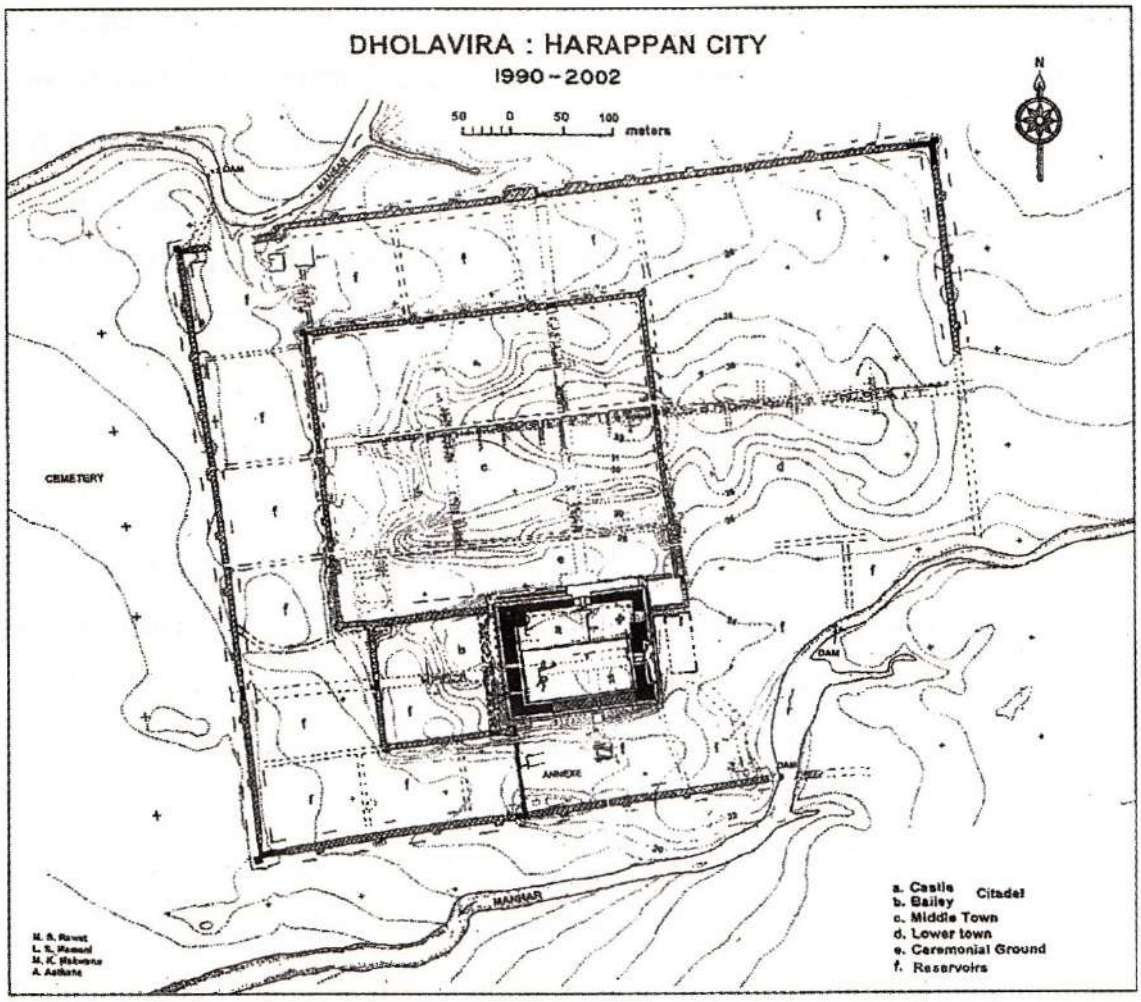

Fig.1 : Line Drawing

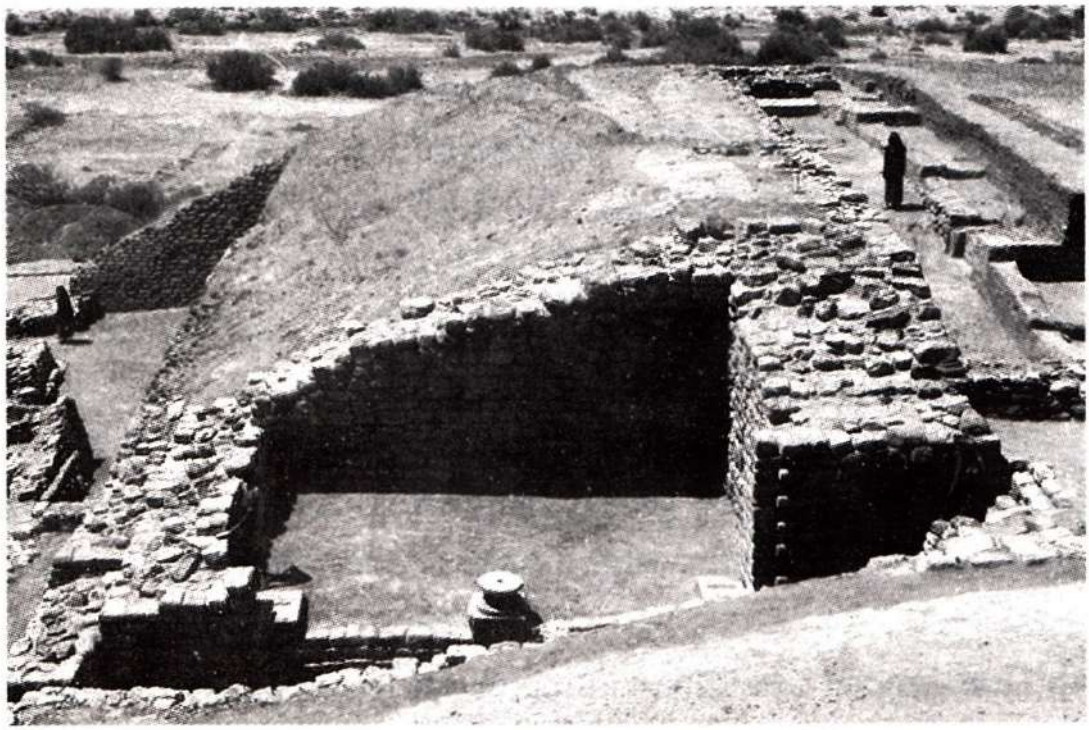

Fig. 2 : Single chamber of east gate of the castle

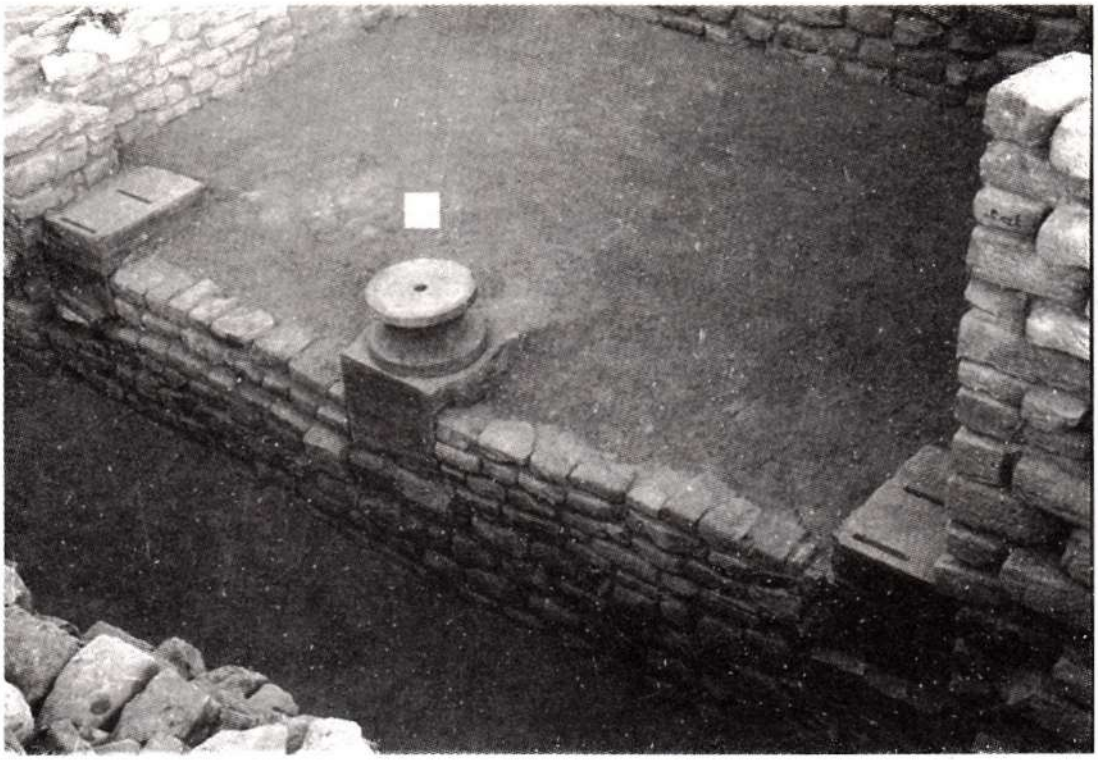

Fig. 3 : Basal elements of central column and pilaster

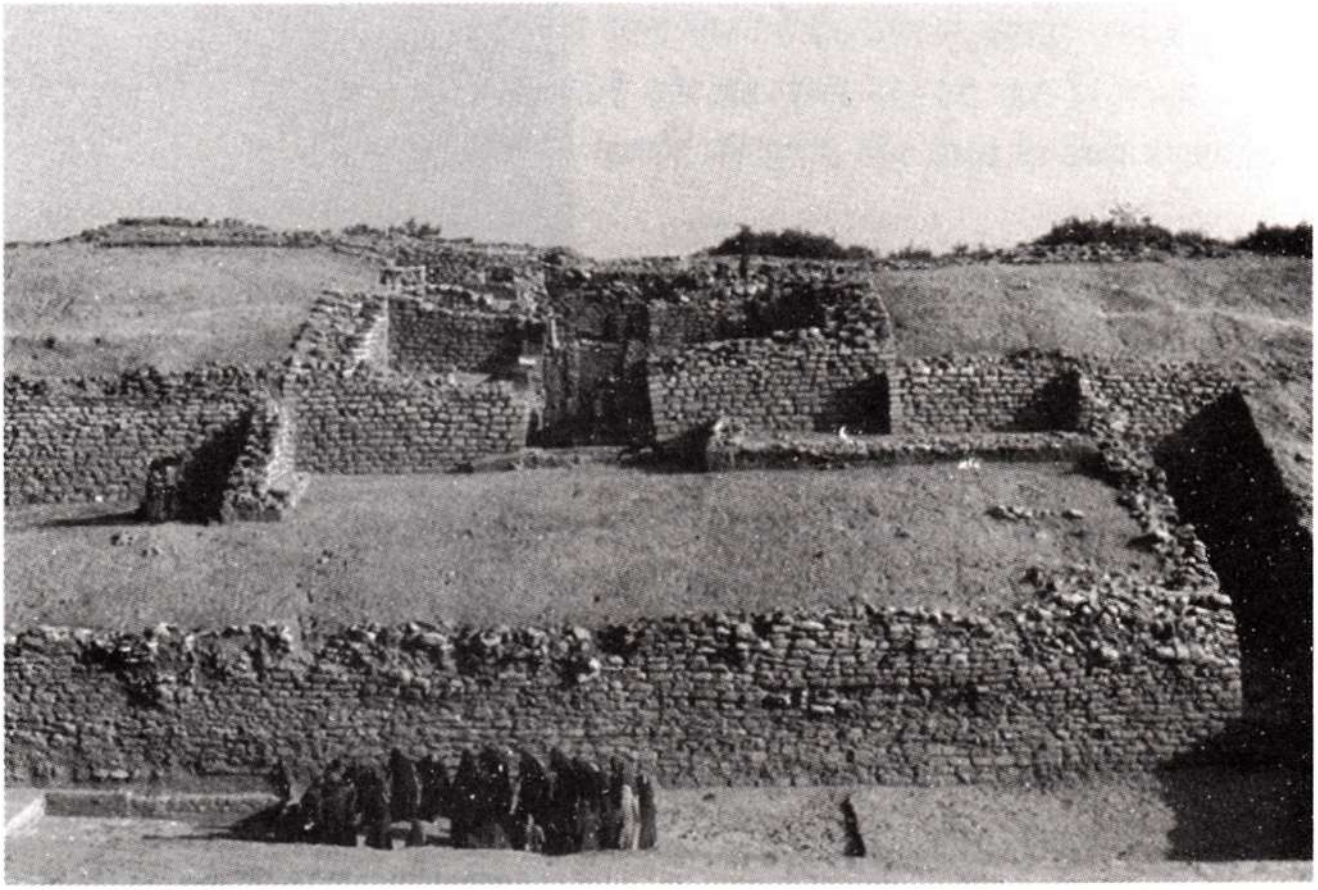

Fig. 4 : North gate of castle, a view from north

Fig. 5 : Rock-cut reservoir between castle and annexe

Fig. 6 : Inside of storm water drain in castle