Indian Journal of History of Science, 40.3 (2005) 337-348

THE FORGE-WELDED IRON CANNON NEAR FATEH BURJ OF GOLCONDA FORT RAMPART

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(Received 16 March 2004; revised 27 April 2005)

The forge-welded iron cannon located near the Fateh Burj bastion of the Golconda fort rampart is addressed in this communication. The date of construction of the cannon is not known with certainty. The engineering design of the cannon has been described. The detailed dimensions of the cannon have been measured. The iron cannon was manufactured using pre-fabricated iron rings, which were forge welded to construct the structure. The inside of the barrel of the cannon is rendered smooth by the provision of 21 longitudinal iron staves, which have been flared out in the front end of the cannon. The iron cannon has been provided with ten handling rings, five on each side. The handling rings have been fixed on handling clamps, located at regular intervals along the length of the cannon. The construction of the cannon has been briefly addressed. The excellent atmospheric corrosion resistance of the cannon has also been noted.

Key words: Iron cannon, Design, Construction, Forge welding.

INTRODUCTION

The skill of the ancient and medieval Indian blacksmiths is amply reflected in the manufacture of numerous large iron objects. Forge-welded iron cannons were some of the significant large iron objects manufactured in medieval India. Some notable medieval Indian iron cannons manufactured by the forge welding technology have been catalogued [1-3]. The wrought iron cannons can be found in different parts of India. They were manufactured from individual iron rings, which were forge welded together. The forge welding technique was the method practiced and perfected in India to fabricate small and large iron objects, notable examples being the Delhi [4] and Dhar [5] iron pillars. It is important to study and catalogue the medieval Indian iron cannons, in order to bring to light these wonderful masterpieces of engineering.

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One of the large iron cannons located at the Golconda fort at Hyderabad will be addressed in this communication. This forge-welded iron cannon is located near the Fateh Burj (bastion) of Golconda fort outer rampart (Fig. 1).

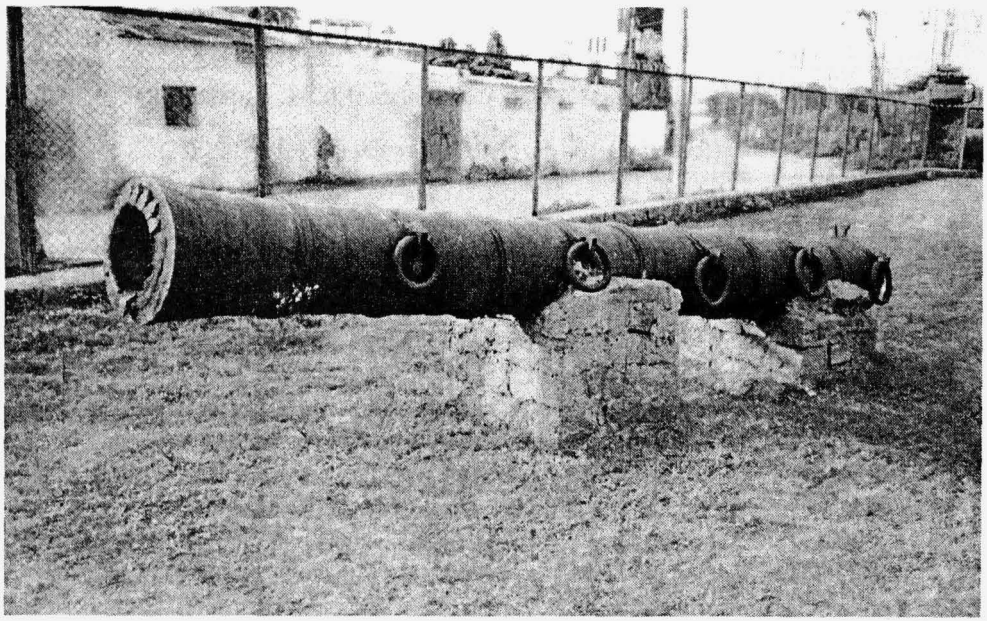

Fig. 1: A view of the forge-welded iron cannon located in the park behind the Fateh Burj of Golconda Fort Rampart.

History

The history of the Golconda fort has been explained in detail in another publication [6], while addressing another massive iron cannon located at the Baḍā Burj of the fort rampart. In brief, the Golconda fort is a majestic monument, which lies on the western outskirts of Hyderabad city in the Indian state of Andhra Pradesh. Golconda is built on a granite hill 120 m high. The fort was founded originally by the Kakatiyas in the 13th century AD. However, the existing structure was expanded by the first three Qutub Shahi kings, over a span of 62 years, starting from 1525 AD.

The Golconda fort is fortified with two lines of defences. The inner rampart, about 5 km in circumference, protected the palaces and garrison, which were located on the Golconda hill. The outer rampart, surrounding the entire township of Golconda, is about 11 km long, and this was also strongly forti-

fied. At regular intervals, the outer fortified wall is provided with *burj*s (bastions). At these bastions, iron and bronze cannons were strategically located. The forge welded cannon addressed in this communication was originally located at one of these bastions, called *Fateh Burj* (Victory Bastion).

The Golconda fort was captured by the Mughals in 1687 AD [7]. The Mughals located some of their wonderful cast bronze cannons at strategic locations along the outer fort wall. As the cast bronze cannons were provided with trunions, these were originally meant for mobile applications. However, the iron cannons located in the outer rampart of the Golconda fort [6] do not have such provisions. It is therefore reasonable to conclude that the bronze cannons at Golconda fort are from the time of Mughal occupation, while the iron cannons were present even before the Mughals captured Golconda.

The road from Hyderabad to Golconda enters the Golconda fort through a massive gate. This particular gate was heavily fortified and known as *Fateh Burj*. There are three locations on top of the bastion for locating cannons. Two of them are empty and one contains a bronze cannon. However, two iron can-

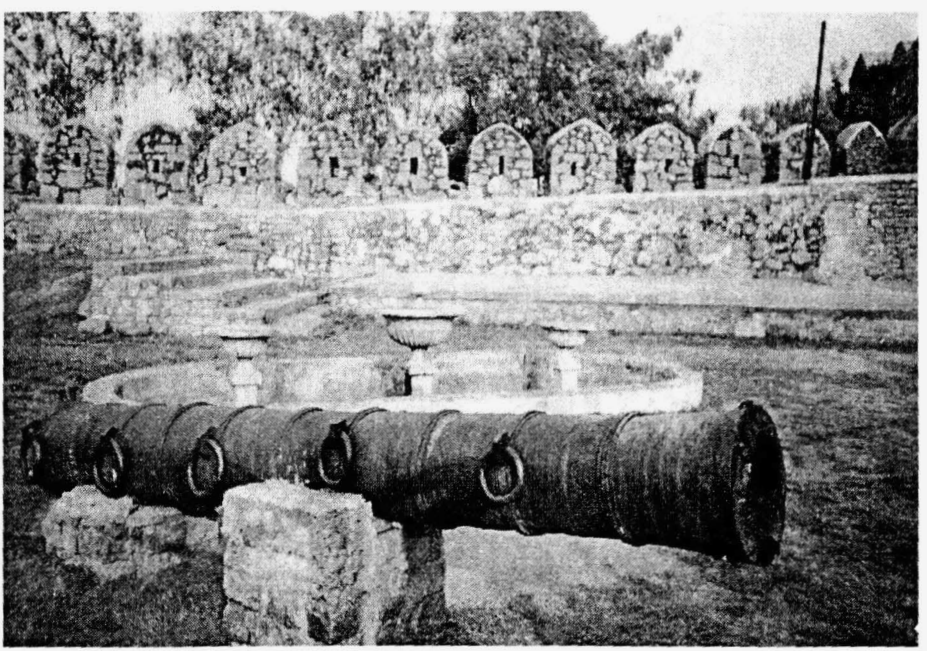

Fig. 2: Another view of the forge-welded iron cannon located in the park behind the Fateh Burj of Golconda Fort Rampart. The rampart wall can be seen in the background.

nons are located at the bottom of the bastion in a field, which is currently used as a public park (Fig 2). The forge welded cannon may have occupied one of the two unoccupied positions. It is reasonable to propose that it must have originally been located on the bastion of the rampart in order to defend the gate against attack. Moreover, the relatively robust size of the cannon coupled with the provision of handling rings on the side of the cannon indicate that it must have been possible to move the cannon quite easily to take up the required position, as the need arose.

Another cannon is located by the side of the forge welded cannon in the park (Fig 3) and this could have occupied the third cannon position on the *Fateh Burj*. It is the forge welded cannon, two views of which are presented in Figs. 1 and 2, that will be addressed in the present communication.

Nothing is known from historical sources about the construction of the forge welded cannon located near Fateh Burj. There are no recorded inscriptions on the cannon outlining its history and time of construction. It has been quoted by the officials of the state archeological department of Andhra Pradesh that the name of the cannon may probably have been *Fateh-e-Raibār*, a Persian

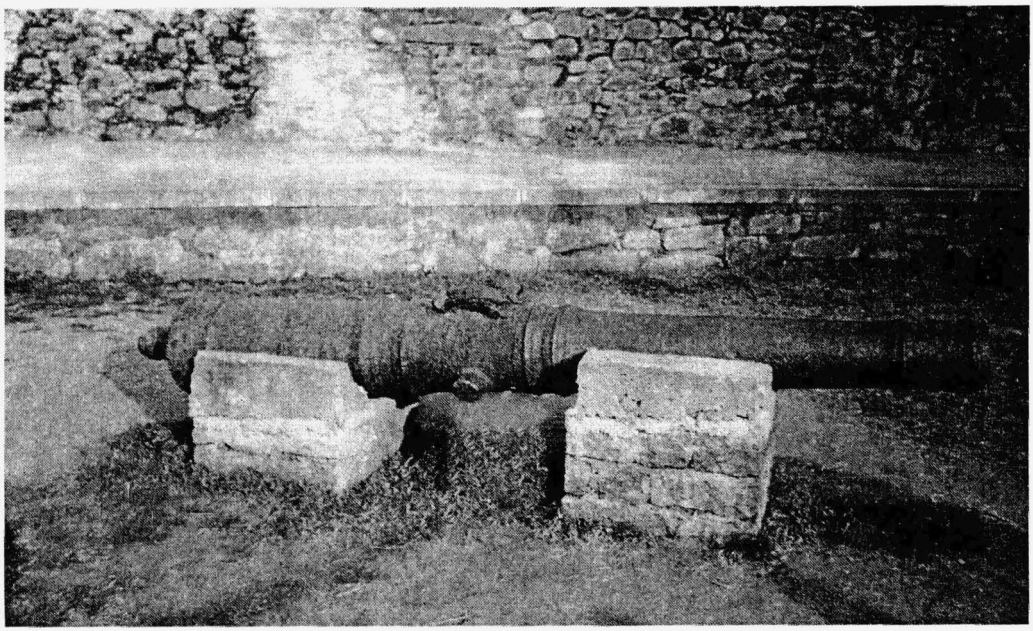

Fig. 3: Iron cannon located in the park behind Fateh Burj by the side of the forge-welded cannon under study. This cannon appears to be a cast iron cannon.

word which translates as "Leader of Victory". As the date of manufacture of the cannon is not known, it can be conservatively placed to the time (around 1687 AD) when the ramparts were strengthened after the Mughals conquered Golconda.

Design

The cannon is placed on two concrete supports, which rest on the ground. The front concrete support is higher than the rear one and therefore the cannon rests at an angle. The front concrete support is approximately 39 cm long, 29 cm wide and 24 cm high while the rear support is 35 cm long, 29 cm wide, and 18 cm high. The distance between the two concrete supports is 42 cm. Water accumulates inside the barrel of the cannon during the monsoon season due to its inclined position. It is important to place the cannon on leveled supports so that this may be avoided.

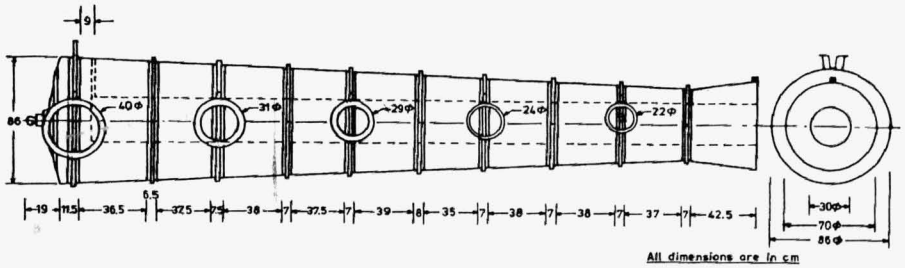

Fig. 4: Schematic of the forge welded iron cannon showing major dimensions.

The cannon is a muzzle-loading type cannon, similar to other medieval forge-welded iron guns[1,8,9]. A schematic drawing of the cannon showing the measured dimensions (in centimeters) is provided in Fig. 4. The total length of the forge-welded cannon is about 474 cm. This total length includes the projected length of 19 cm at the rear end. The cannon is a tapered structure, exhibiting two kinds of taper. The diameter at the front face is 70 cm and this tapers down to 63 cm at a distance of about 42 cm from the front. The cannon barrel again tapers up with increasing diameter till the rear end of the cannon. The outer diameter of the cannon at the rear end is 86 cm. The inner diameter of the cannon, measured on the front face, is 30 cm. The weight of the tapered cylindrical cannon barrel can be estimated as 12610 kg, based on the dimensions measured.

If we assume all the medieval cannon design to be similar, then the portion from the fuse hole to the rear end of the cannon is a solid metal and not a hollow cylinder as the rest. The distance between the fuse hole and the rear end of the cannon is about 21 cm. This rear portion therefore adds an extra weight of about 930 kgs to the total weight of the cannon.

Fig. 5 shows the front view of the cannon. The end portion of 8 remaining iron staves have been flared out on the cannon front face and can be still seen. There are 21 long rectangular iron strips that are placed around the circumference of the inner bore and these run through the entire length of the inside of the barrel. These have been welded on to the inner surface of the barrel. They provide a smooth surface and also wear resistance for the projectile material flow. All these strips were folded towards outside over the front face. Only 8 of these still remain with the other having chipped/fractured off the front face. Each strip is about 5 cm wide and 2.4 cm thick.

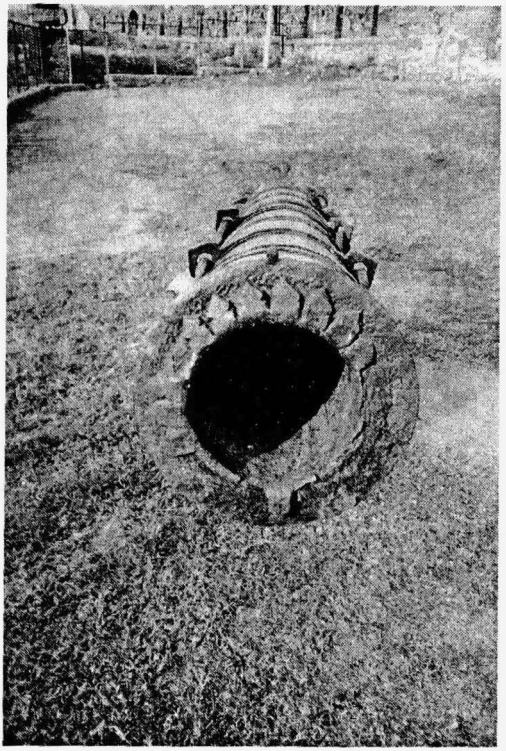

Fig. 5: Front view of the cannon showing remaining of iron staves that have been folded out on the front face. There are a total of 21 staves along the inner circumference of the barrel.

Three concentric rings are also discernible in the front plane of the cannon barrel (Fig 5). This implies that the thickness of the gun barrel is composed of three layers of iron rings, similar in design to the Thanjavur cannon [8].

While observing the outer surface, it is noted that there are ten three-ring assemblies, located equidistant along the barrel (see Figs. 1 and 2 for overall arrangement and Fig. 6 for details). The number of rings that make up the three-ring assembly is 30, as seen on the external surface. In between each of these assemblies, 7 iron rings of greater width are located. Each of these iron rings are 4 cm wide. Therefore, the total minimum number of rings along the external barrel is 100. Assuming a three-layered ring assembly for the barrel thickness, these are at least 300 rings, which were used in the construction of the cannon barrel. The total number of iron rings in the rear portion is not known with certainty. However, based on the appearance of the external surface, the minimum number of rings counted is 5.

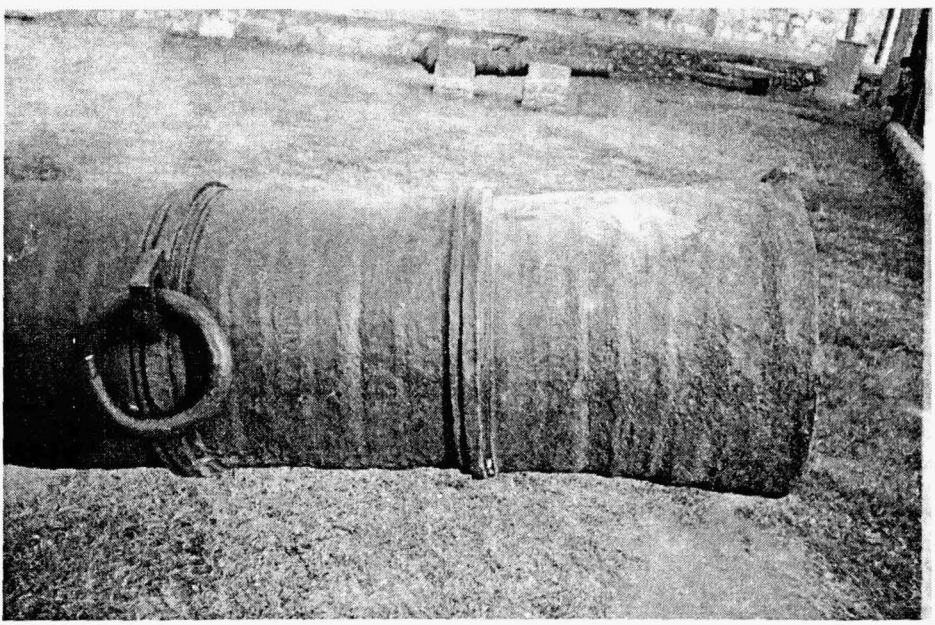

Fig. 6: Side view of front of cannon showing details of two three-ring assemblies, which have been placed at regular intervals to strengthen the barrel. Note that while the first assembly does not contain provisions for handling clamps, the second contains two handlings clamps through which iron rings have been placed.

Ten handling rings are provided at both sides of the cannon, five on each side. They are located in a symmetrical fashion on both sides of the cannon. There are five rings an each side, placed at a distance of approximately 88 cm between each other. These rings were probably used for handling the cannon during its use. As noted above, the cannon appears to have been strengthened by providing external three-ring assemblies (see Fig 6). These external three-ring assemblies are placed at regular intervals along the gun barrel. At every alternate three-ring assembly, two clamp plates are provided to hold the handling rings (see Figs. 7 and 8) on both side of the barrel. These clamp plates have been placed near the top surface of the cannon. Handling rings have been provided through these clamps. The clamp plate is about 2.4 cm thick, 10 cm high and 12 cm wide. The clamp plate possesses a bore of diameter about 6 cm. These holes are used to hold the handling rings. The diameter of the ring increases from 22 cm in the front of the barrel to 40 cm at the rear. These clamps and rings add about 20 kgs to the cannon's weight.

As estimated before, the cannon barrel weighs 12601 kgs, while the rear solid portion provides 930 kgs. Therefore, the approximate total weight of the cannon is about 13560 kgs!

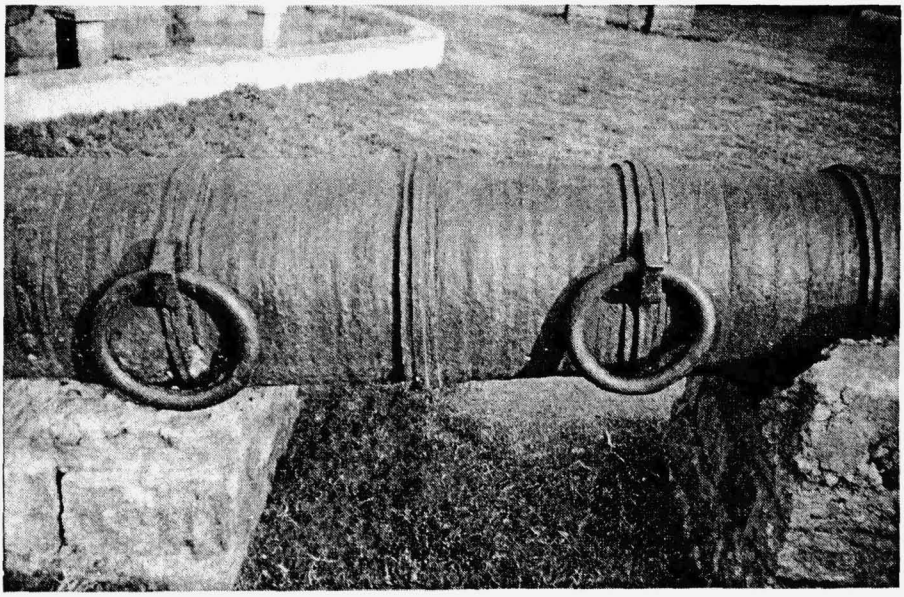

Fig. 7: Side view of the cannon in the middle portion of the cannon.

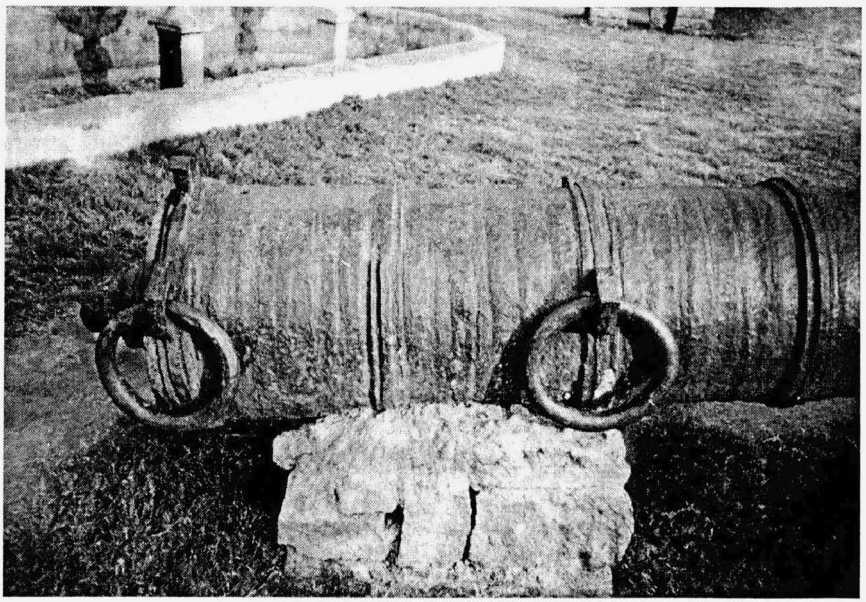

Fig. 8: Side view of the cannon in the rear portion of the cannon.

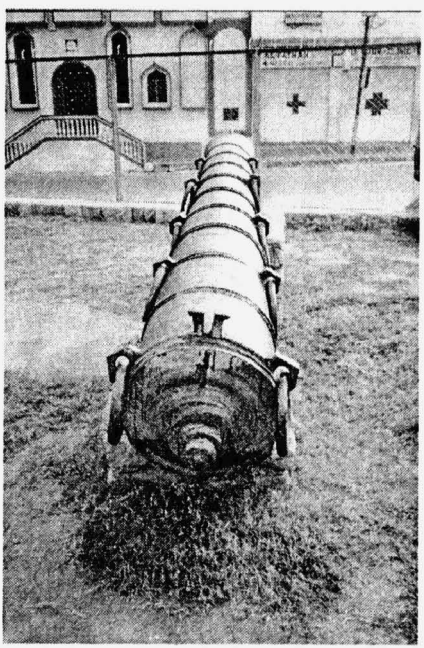

Fig. 9: Rear portion of the cannon. Note the provision of a split vertical marker provided on the top of the barrel. This must have been used for aiming the direction of fire.

The side view of the rear end of the cannon is shown in Fig 8, and the end view in Fig 9. It is seen that the rear end is not flat but consists of successively smaller diameter circular iron rings. A fuse hole, of 3 cm diameter, is located on top surface of cannon near the rear end and this was used for ignition of gunpowder. The distance from the end of the cannon barrel to the extreme end of the cannon is 19 cm.

The rear end of the cannon is an important location because this section has to withstand the impact loading caused by the exploding gun powder. Its constructional details can be seen Fig 9. The central portion in the rear region must be constructed of a solid cylinder of iron, and assemblies of rings have been forged on to the solid cylinder to construct the rear structure. The material from the fuse hole to the rear of the cannon is solid. In this manner, this cannon resembles other medieval iron cannons in its construction [1,8,9].

The rear end of the barrel also possesses two handling clamps, through which handling rings are placed. Interestingly, a special provision (split vertical marker) is provided on the top of the rear of the cannon, to aid aiming of the cannon (see Fig. 9). This is aligned with another smaller projection in the front face of the cannon (see Fig. 5). These additional features may have been used for pointing at the target before firing the cannon.

The construction methodology of the cannon appears to be similar to the other large medieval forge welded iron cannons [8,9] This can be briefly described as follows. The long iron staves were laid out longitudinally and the three layers of pre-fabricated iron rings were shrunk fit over the iron staves and joined together by forge welding. The engineering design and skill of the medieval blacksmiths must be appreciated because the pre-fabricated iron rings had to be manufactured with precise control of dimensions.

The cannon does not appear to be severely corroded on the surface. However, rust scales could be seen in the inner bore of the cannon on the lower side only. This is due to accumulation of water in the cannon, because the cannon is placed on the concrete supports in an inclined position. Water accumulation acerbates corrosion. However, the excellent atmospheric corrosion resistance of the cannon must be appreciated by the almost corrosion free external surface. Samples from the cannon were not analyzed, but it is anticipated that

the material of construction must be phosphoric iron, based on similar observations on other medieval forge welded cannons of India. The presence of phosphorus provides improved atmospheric corrosion resistance[10,11]. The rust from the cannon needs to be characterized for its constituents and several sophisticated methodologies are available for the same[12].

Summary

The forge welded iron cannon located near the *Fateh Burj* (bastion) of the Golconda fort rampart has been studied for its design and construction. The date of construction of the cannon is not known with certainty. The engineering design of the cannon has been described, based on analysis of its detailed dimensions. The cannon is a muzzle loading type cannon. The cannon was manufactured using pre-fabricated iron rings, hooped and forge welded over longitudinally placed iron staves. The inside of the barrel of the cannon is rendered smooth by the provision of 21 longitudinal iron staves, which have been flared out in the front end of the cannon. The iron cannon has been provided with five sets of handling rings, which have been fixed on handling clamps along regular intervals along the length of the cannon. The probable construction methodology of the cannon has been briefly addressed. The excellent atmospheric corrosion resistance of the cannon has also been noted.

Acknowledgement

The authors acknowledge the support and assistance of the Archeological Survey of India.

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