Littlehampton Fort and its Carnot Wall

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Littlehampton Fort Restoration Project

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Introduction

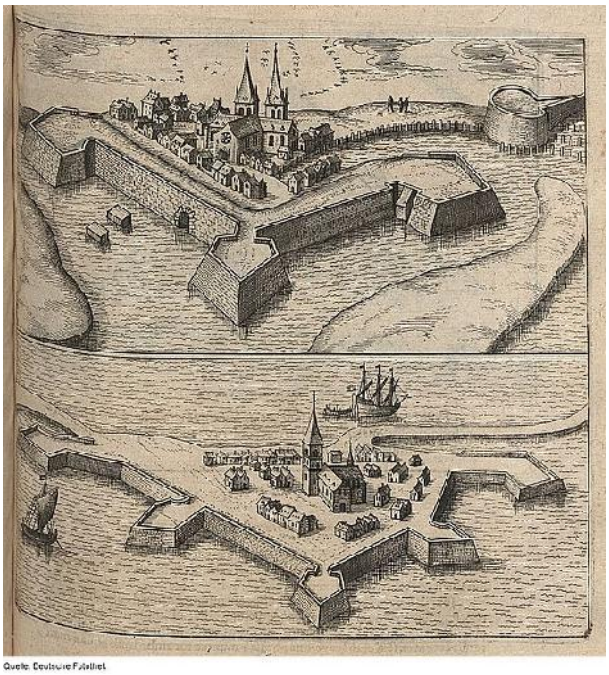
This article has been produced as part of the research by members of the Littlehampton Fort Restoration Project. Littlehampton Fort, built in 1854, lies at the mouth of the river Arun in West Sussex. It is now (2012) in a ruinous and overgrown state. The Project aims to protect, preserve and develop the fort.

This article seeks to put the design of Littlehampton Fort in the context of the changes in fortification design at the time. In the process the intention is to bring out the significance of the design of the fort, which appears to have been somewhat overlooked.

The bastion system

From the end of the seventeenth century onwards the conventional design of fortifications was based on the bastion "trace" or ground-plan. Although this had originated in Italy in the 16th century[1], its greatest exponent was considered to be the Marquis de Vauban (1633 to 1707), Louis XIV's military engineer[2]. Vauban was a master both of the successful attack of fortifications and of their design. His methods were taken as a model for the construction of subsequent fortifications until well into the nineteenth century[3]. This can be seen in Henry Yule's manual for officers and students of fortification of 1851. Yule devotes most of his book to describing Vauban's system of fortification, leaving the description of the ideas of later engineers until his final two chapters and appendices[4].

The trace, or ground plan, of a fort consisted of earth ramparts topped by gun platforms with a surrounding ditch. Bastions were four-sided projections from the outline of a fort, with somewhat of the shape of a blunt arrow-head. Their object was to allow defenders to fire along the flanks of the ramparts at approaching attackers. In the full bastion trace further defences were erected in front of the ramparts and bastions. The purpose of these was to impede besiegers and to give defenders extra platforms from which to fire. These various projections led to such fortifications being described as "star forts"[5].



Drawings of forts with bastions (1624)
Attribution: By Robert Fludd (Deutsche Fotothek) [Public domain], via Wikimedia Commons.

Plan of Fort Barraux by Vauban, 1692. An example of a bastion trace fort, showing the "star" outline.

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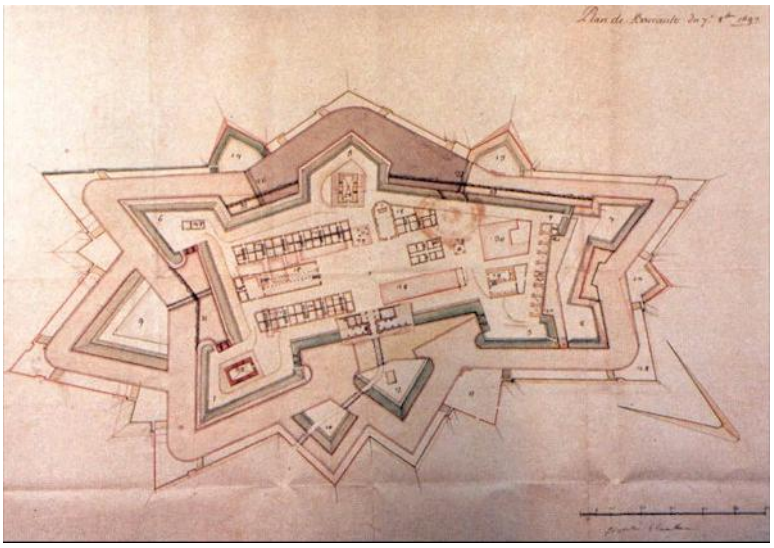


Later eighteenth and early nineteenth century developments

In the later eighteenth century new ideas began to emerge, especially among French engineers. Technological changes played a part in this. There were improvements in the manufacture of artillery, making it quicker and cheaper to produce guns and innovations in gun carriage design[6].

The French engineer Montalembert (1714 to 1800) formulated radical changes in fortification design in his book published in 1776. He emphasised the need for overwhelming fire against defenders. This meant that there should be as many cannons as possible, housed in protective "casemates", which were strengthened chambers within the ramparts. He recommended lengthened curtain walls. The bastions were replaced with fortified projections across the ditch with loopholes for riflemen called "caponiers"[7].

A younger French engineer, Lazare Carnot (1753 to 1823), further developed these ideas. He too opposed the bastion trace. His system, published in a work of 1810 in France, translated into English in 1814, emphasised the power of vertical fire from mortars, housed in casemates on the ramparts, against attackers[8]. Carnot also introduced controversial changes to the nature of the surrounding ditch and associated defences. (As we shall see below these were to be important in the design of Littlehampton fort).

In a conventional fort the ramparts were surrounded by a ditch with vertical, or near vertical, sides, called the "scarp" (inner wall) and "counterscarp" (outer wall). The outer side of the ditch would have a "glacis", a gently outwardly sloping earth bank at a slightly lower level than the ramparts. The glacis would be topped by a parapet with a flat area called the "covered way" (because it was "covered" by fire from defenders on the ramparts). This arrangement was intended to make it difficult for attackers to approach the fort while

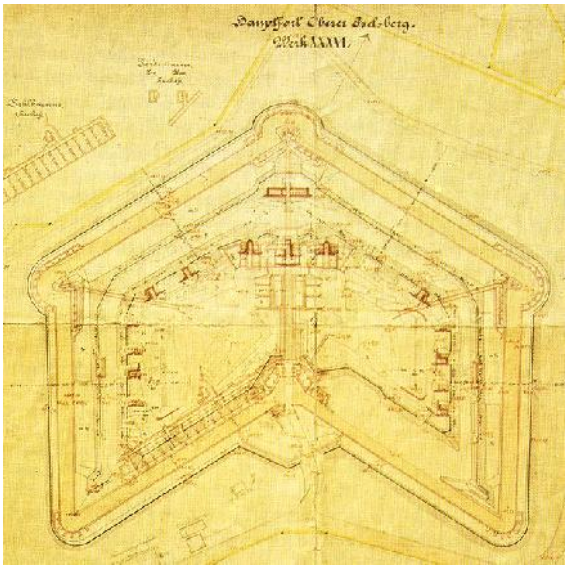
allowing defenders to observe, and fire on, approaching besiegers at some distance from the fort[9].

As against this method Carnot's system did away with the covered way and steep counterscarp and made the glacis slope back into the ditch. (This is referred to as a countersloping glacis)[10]. He placed a loop-holed wall in the ditch of the fortification. This had a "chemin des rondes", or sentry path, to the rear allowing defenders to move along behind the wall. As well as firing at attackers the defenders were able to make sorties from behind the wall up the countersloping glacis.

Polygonal Forts

After the final defeat of Napoleon in 1815 engineers continued to develop fort design. From this process the “polygonal trace” emerged among Prussian and Austrian engineers [11].This followed on from the ideas of Montalembert and fellow French engineers. Polygonal forts had no bastions, long sides (giving the name to the system) with obtuse angles, and included casemates and caponiers.

Such forts were built along the Rhine and Danube rivers, in Austria at Linz and Salzburg, and in northern Italy[12].



A plan of a polygonal fort.
Fort Oberer Eselberg, Ulm, Germany, built 1881 to 1887.

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Technological changes in ships and naval gunnery at this period were affecting the design of forts. Shells, as opposed to cannon balls, were used by the French from 1837, and rifled guns from 1842. These developments led to more accurate and powerful artillery. At the same time iron, or iron-clad, steam screw and propeller ships were being introduced[13]. In 1847 Sir John Burgoyne, the Inspector General of Fortifications, wrote of the “force and

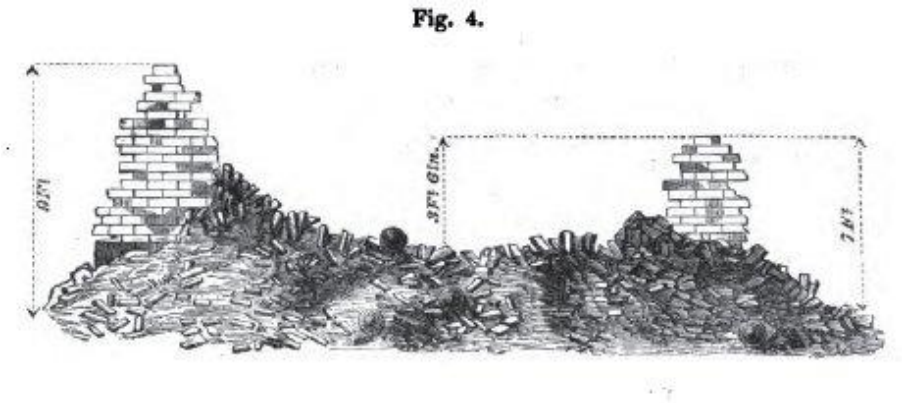
speed of steam vessels" which had to be countered by coastal gunners[14]. Polygonal forts, with their long sides could be equipped with more guns for this purpose.

In the 1840s British engineers experimented with polygonal designs. Shornemead Fort, on the Kent side of the Thames estuary, was built between 1847 and 1853. With its pentagonal plan it was the first fully polygonal fort in Britain[15].

British fort design 1815 to 1840s

British military engineers followed developments on the continent with interest. Major-General Sir John Jones R.E. made two visits a year to inspect the new fortresses being built or restored on the Rhine and in Belgium[16]. Carnot's system however was resisted in Britain. Objections included: the excessive manpower and firepower required[17]; the vulnerability of the Carnot wall to enemy artillery [18] [19]; that sorties were a poor defensive tactic[20]; and that vertical fire was not as effective as Carnot asserted[21].

Experiments to test the Carnot wall concept were carried out at Woolwich, Kent in 1824 on a replica wall. This was 21 feet (6.4 metres) high and 22 feet (6.7 metres) long. The thickness tapered from 7 feet (2.1 metres) at the base to 6 feet (1.8 metres) at the top. Ramparts of equal height were built in front of the wall[22]. The artillery fired at high angles over the ramparts. It was concluded that the wall could be severely damaged even when the besieging gunners were unsighted.



The replica Carnot wall built at Woolwich in 1823, drawn after the 1824 experiments. Source: Douglas, 1859 page 101

It was later doubted that the Woolwich experiments had really proved what was claimed, because the tests used far more artillery fire than would ever actually be used against such a wall in the field[23].

The objectors did not hold sway indefinitely however and forts with Carnot walls were eventually built in Britain. In his 1849 book James Fergusson outlined the advantages of the Carnot wall, though without wholly endorsing its use[24]. He said that such walls would be cheaper to construct. They would last longer than the usual scarp wall with a "mass of earth at its back always tending to overthrow it". In addition it would be difficult to scale the wall as the besiegers would have to use ladders to reach the top and the same ladders to descend the other side, while all the time facing assault by defenders [25]. Fergusson also commented that the 1824 Woolwich experiments, which had influenced subsequent fort design, had given "every possible advantage in favour of the attack"[26]. He argued that, even were a breach to be made in the wall, the defenders could easily attack the besiegers, making an assault on the fort hazardous. His final point was that in any case the wall would be hidden behind a rampart far higher, in relation to the height of the wall, than that at Woolwich, so that the enemy artillery would be not able to significantly damage it[27].

Littlehampton Fort and its Carnot Wall

The historian of West Sussex defences, John Goodwin, says that there was little that was remarkable about the plan of the fort, which followed conventional practice[28]. The fort had a “lunette” shape, with the ramparts for the guns facing in two directions to cover the beach and river approaches. To the rear of the ramparts a defensible barrack block closed the “gorge” of the fort.

Goodwin says that there was one “novel” feature - the Carnot wall. However the design of the fort adopted this feature of Lazare Carnot’s system without all of the other elements. Its inclusion looks like a pragmatic decision, rather than a slavish following of Carnot’s ideas. Andrew Saunders suggests that the Carnot wall built two years later at Shoreham Fort may have been employed because it was difficult to excavate a deep ditch in shingle[29]. Similar considerations could have applied at Littlehampton.

In Carnot’s system the detached loop-holed wall was to be put in front of the ramparts. The counterscarp (outer) side of the ditch was to be gentle slope allowing the defenders to attack up it – the countersloping glacis. At Littlehampton the counterscarp had a vertical wall. Clearly emphasis was placed on the ability of defenders to fire on attackers at the top of the wall and in the ditch.

An aerial view of Littlehampton fort, showing the ramparts, Carnot wall and vertical counterscarp.

The near contemporary fort in Ancona, Italy similarly had a Carnot wall with a vertical counterscarp.

Littlehampton also omitted other features of Carnot's system; there was apparently no intention for mortars to provide vertical fire; no casemates and no caponiers. In place of the latter the wall was made to turn at angles and then back in on itself to form open bastions. This may have been done to save on materials and labour.

Littlehampton Fort as seen by historians

So far as is known Littlehampton was the first fort to be built in Britain with a Carnot wall; a feature seen in several later forts of the 1850s and 1860s. The fort thus shows the experimentation in the design of British forts of this period[30]. There is some evidence that the significance of the fort's design has been underappreciated. Andrew Saunders, the former Chief Inspector of Ancient Monuments at English Heritage, states in his book "Fortress Britain" that Shoreham Fort, built in 1856, was the first in Britain to have a Carnot wall[31]. This mistake arose because he believed Littlehampton Fort not to have been built until 1859[32]. In his survey of the fort in 1981 F. G. Aldsworth describes the wall but does not mention that it was an innovation[33].

It is hoped that the restoration of the fort will be accompanied by greater recognition of its place in the history of British fortification.

Glossary

[The definitions in the glossary are taken from Henry Yule's 1851 book[34], except those for words shown in *ITALICS*].

BASTION. (From Old French *Bastir,* to build.) In an extended sense, is any projection from the general outline of a fortress, from which the garrison is enabled to see, and defend by a flanking fire, the ground before the ramparts right and left.[…] This has been the leading feature in most systems of fortification for the last three hundred years.

CASEMATE - (From Spanish *Ca'a,* house, ad *Maui;,* to murder.) A covered flanking embrasure or battery; a bomb-proof vault, generally under the ramparts of a fortress, used as a barrack or a battery, or for both purposes.

CAPONIER/ CAPONIERE - (From the Ital. *Capannato, a* cottage) A covered passage athwart the ditch of a fortified place, for the purpose either of sheltering communication with outworks, or of affording a flanking fire to the ditch in which it stands.

CARNOT WALL – a detached wall at the foot of a rampart with loop-holes and a *chemin des rondes* behind it.

CHEMIN DES RONDES - passage or sentry path at top of the scarp wall with a parapet for cover.

COUNTERSCARP - The outer boundary of the ditch, which is generally faced or revetted with masonry, to render the descent into the ditch difficult.

COVERED WAY - A protected communication all round the works of a fortress, on the outer edge of the ditch.

GLACIS - The parapet of the covered way extended in a long slope to meet the … surface of the ground, so that every part of it shall be swept by the fire of the ramparts. The glacis conceals the masonry of the escarp from distant cannonade.

GORGE - (French the throat.) The rear, whether opened or closed, of any work, having its aspect to a definite front.

LOOP-HOLE - an opening in a wall to fire muskets through.

LUNETTE - A work shaped like a detached bastion - i.e. with two faces and two flanks.

RAMPART - (*riparo,* from Lat., *reparare.)* In a fortification, is the mass of excavated earth on which the troops and guns of the garrison are posted, and on which the parapet is raised.

REVETMENT - A facing to the steep sides of a ditch or parapet. In permanent works, it is usually of masonry; in field-works it may be of timber, turf, hurdles, or other material at hand.

SCARP - Outer slope or revetment of a rampart or inner side of a ditch.

References

[1] Christopher Duffy, *Fire & Stone: The Science of Fortress Warfare 1660-1860.*, First. (Newton Abbot: David & Charles, 1975), page 9.
[2] Ibid., page 16.
[3] A D Saunders, *Fortress Britain: Artillery Fortification in the British Isles and Ireland* (Liphook: Beaufort Publishing, 1989), page 133.
[4] Yule, Sir Henry, *Fortification for Officers of the Army and Students of Military History* (London, 1851).
[5] Saunders, *Fortress Britain*, page 64.
[6] Ibid., page 134.
[7] Ibid., page 135.
[8] Ibid., page 156.
[9] Duffy, *Fire & Stone: The Science of Fortress Warfare 1660-1860.*, pages 59–63.
[10] Lazare Carnot, *A Treatise on the Defence of Fortified Places: Written Under the Direction and Published by Command of Buonaparté, for the Instruction and Guidance of the Officers of the French Army* (London: Printed for T. Egerton, 1814), page 204.
[11] Saunders, *Fortress Britain*, page155.
[12] Ibid., page 156.
[13] Ibid., page 160.
[14] Burgoyne, Major-General Sir John in Corps of Royal Engineers, *Corps Papers, and Memoirs on Military Subjects: Compiled from Contributions of the Officers of the Royal Engineers and the East India Company's Engineers* (s.n., 1848), page 101.
[15] Saunders, *Fortress Britain*, page 162.
[16] Sir Howard Douglas, *Observations on Modern Systems of Fortification: Including That Proposed by M. Carnot, and a Comparison of the Polygonal with the Bastion System; to Which Are Added, Some Reflections on Intrenched Positions, and a Tract on the Naval, Littoral, and Internal Defence of England* (London: J. Murray, 1859), pages 89–90.
[17] Ibid., page 81.
[18] Ibid., page 148.
[19] Auguste Frédéric Lendy, *Treatise on Fortification: Or, Lectures Delivered to Officers Reading for the Staff* (London: W. Mitchell, 1862), page 453.
[20] Douglas, *Observations on Modern Systems of Fortification*, page 111.
[21] Lendy, *Treatise on Fortification*, page 49.
[22] Douglas, *Observations on Modern Systems of Fortification*, page 97.
[23] Ernest Marsh Lloyd, *Vauban, Montalembert, Carnot: Engineer Studies* (London: Chapman and Hall, 1887), page 194.
[24] James Fergusson, *An Essay on a Proposed New System of Fortification: With Hints for Its Application to Our National Defences* (London: J. Weale, 1849), page 54.
[25] Ibid., page 54
[26] Ibid., page 55.
[27] Ibid., page 55.
[28] John Goodwin, *The Military Defence of West Sussex*, 1st ed. (Midhurst: Middleton Press, 1985), page 36.
[29] Saunders, *Fortress Britain*, page 165.
[30] Ibid.
[31] Ibid.
[32] Ibid., page 239.
[33] Aldsworth, F. G., "A Description of the Mid-nineteenth Century Forts at Littlehampton and Shoreham, West Sussex," *Sussex Archaeological Collections* 119 (1981): page 184.
[34] Yule, Sir Henry, *Fortification for Officers of the Army and Students of Military History*, page 184.