

# Good report about thames tunnel: engineering wonders

[Countries](#), [England](#)



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## **Thames Tunnel: Travelling under the river**

Recognized as engineering virtuoso, Isambard Kingdom Brunel is also acknowledged for his audacious plans and colossal structures that are critical parts in even today's times. Brunel amalgamated innovation and immeasurable boldness of foresight in constructing his oft contentious " trophies." Born to French and English parents, Brunel began his internship with his father on the building of London's Thames Tunnel. Soon after, Brunel was designated as the projects' resident engineer; aside from being the lead engineer, Brunel was also able to gain considerable knowledge and exposure on cement and brick structures that would serve him in his future projects (Network Rail, n. d., p. 1).

## **The Thames Tunnel: A new way to connect London**

In the early part of the 19th century, extreme crowding in London, specifically in the bustling dockyards in the eastern part of the city, was becoming a serious issue. This congestion was being worsened by the increasingly foul smell emanating from the Thames River that traversed the city. Though building more bridges over the river would have helped in

alleviating the congestion in the city, the builders would have to design the bridges in such a way that these can accommodate the passage of high masted ships through the River (Brunel 200, n. d., p. 1).

Brunel's time saw the Thames congested with tall sailing ships waiting to discharge or load various cargoes at all times of the day. With London rapidly expanding, and with the amount of commerce at its ports growing in parallel with the size of the city, the spans traversing the breadth of the Thames-the London Bridge and Blackfriars bridge- were being overwhelmed. Building a bridge was not an alternative in relieving the pressure on the city; the ships that warranted the building of new bridges were also the reason that the bridges would be unviable. The bridge would have to be high enough to accommodate the masts of the ships, or be lifted as in " bascule bridges;" however, the size of the bridge would make it technically impossible to apply the technology in London (London Reconnections, 2014, p. 1).

The recommendation to construct the tunnel had to consider the factor of these ships sailing up and down the Thames River. At the time, London's port was the most bustling facility in the world as well as the transshipment hub for the British Empire. Bridges that would be built to span the Thames would have to compensate for the 100-foot masts; during that time, the lifting mechanisms for the present day Tower Bridge was not developed yet (Brunel Museum, n. d., p. 1).

Searching for an alternative, the Thames Archway Company was established in 1805 with the objective of building a tunnel to course beneath the Thames. In the primary phase of the construction, Richard Trevithick, a miner and engineer from Cornwall, was designated to oversee the initial

building of the Tunnel. Trevithick began building a “ drift way” or “ pilot tunnel;” unfortunately, the common method of supporting the walls and gambrel of the tunnel had failed in the unconventional environment. After a number of flooding in the area, the project was eventually discarded.

Regrettably, the tunnel was just 200 feet, or 61 meters, short of the objective. In 1809, the Thames Archway Company was dissolved (Brunel 200, n. d., p. 1).

A little over a decade after the dissolution of the Archway Company, Marc Brunel, Isambard’s father, developed a “ tunneling shield” composed of iron; the use of the element was inspired by the “ ship worm,” which was known to have the ability to penetrate the timbers of a ship. The shield would protect the excavators, who will be stationed in various compartments in the shield, burrowing through earth held back by wooden planks, which were then reintegrated one at a time to permit access to the tunnel face. At the same time, the bricklayers, working closely behind the buffer, would be working to construct the lining of the tunnel (Brunel 200, n. d., p. 1).

Brunel’s buffering mechanism was rectangular in shape with 12 excavating positions in the front of the shield with three positions designed one on top of the other; in all, 36 diggers formed the head of the digging apparatus. The method was simple enough; excavate approximately four inches of earth, reintegrate the boards, replace the beams and begin the process again (Brunel Museum, n. d., p. 1).

The “ ship worm” approach was the method sought to apply to the project. The elder Brunel observed that the worm penetrated into the woodwork of the ship by utilizing “ shell like projections” located on its head to accomplish

the digging, and then digesting the coagulated wood. Brunel would develop a machine that would dig through the terrain and convey the earth via the tunnel mechanism. The mechanism itself would be the support for the tunnel while the bricklayers would lay the lining. Though Brunel found it difficult to implement the original planning, Brunel was undaunted and altered the plans.

Rather than using a machine, Brunel decided to deploy people at the excavation area of the tunnel. The “ shield” Brunel developed consisted of 36 smaller compartments, with each chamber spacious enough to hold a single worker. Each of the compartments faced six level boards, with each of the boards removable by the worker in the chamber; this will allow the occupant of the chamber to remove the earth located behind the chamber. Once the earth was removed, the panel could be reintegrated and moved forward, holding the rest of the terrain at the back of the tunnel. When the miners inside each of the compartments had removed all of the panels, the whole machine was then moved forward. The frame of the shield supported the roof temporarily and the bricklayers would then line the tunnel with a permanent lining (London Reconnections, 2014, p. 1).

When the dirt within the proximity of the boards had been excavated, the boards, or the shield, moved would be moved forward to start the process over. Persuaded that the buffer made the plan to construct a tunnel under the river more viable, the Thames Tunnel Company was established in 1824 with the elder Brunel designated as the head engineer. It was presumed that the workers would face solid clay formations during the work; however, it was not long that the workers began to encounter loosened gravel, sand, and

decaying sewage. This made the work harder and extremely unsafe (Brunel 200, n. d., p. 1).

The problem of the earth excavated in the tunnel project is not exclusive to this particular project. Ralf Dodd, the man who had proposed the Grand Surrey Canal, embedded a “ test shaft” at Rotherhithe, but stated that the structure of the land was untenable. This was followed by the Thames Archway endeavor in 1805. In the two cases, the composition of the ground ultimately doomed the two initiatives. The turf underneath the Thames was too loose and vulnerable to collapse. This exacerbated the threat that any significant space would probably cave in and be inundated from the water pressure from the River.

This possibility effectively restrained the use of long practiced mining techniques. Trevithick’s proposal was costly; the proposal comprised of building “ coffer dams” to displace the water in the area and then lower iron sections from over the area. However, the plan was laden with risks and extremely expensive and was subsequently abandoned (however, Trevithick’s concept was reasonable-the approach was utilized in San Francisco with a modicum of success) (London Reconnections, 2014, p. 1).

The putrid air in the tunnel site caused the workers to develop illnesses such as fevers and even blindness. One of those that fell ill was William Armstrong, the projects’ head engineer. Armstrong had to resign from his position; Isambard Brunel soon took over the position of Armstrong. Anxious to prove his worth, Isambard would spend days beneath the ground. Fearful for his son’s health-Isambard would work and sleep at or near the shields- Marc assigned Isambard three assistants in a futile effort to decrease his

enormous workload. However, it was the assistants that paid the penalty of the workload. One of the assistants perished owing to fever and one became blind in the left eye.

Though the bricklayers were able to work at a fast pace, there was a possibility that the river would be able to puncture the unsteady space under the riverbed being exposed when the shields are moved. That risk occurred on the 18th of May 1825, when the Thames did puncture the tunnel and resulted in a massive wave rushing through the tunnel. The workers were able to reach the shafts and evacuated the scene (Brunel 200, n. d., p. 1). The deplorable air quality in the tunnel site resulted in many of the workers being hauled up to the surface unconscious; this was meant for them to be able to recover and breathe fresh air. The working areas were also extremely damp with the river water constantly seeping through the roof of the tunnel. What was worse, the water was also mixed with sewage, and this was prior to the development of Sir Joseph Bazalgette's sewerage network for the city of London.

The quality of the Thames River was only slightly different from that in the sewerage lines; the sewage that filtered into the tunnels gave off methane gas that was often times ignited by the candles that gave off an extremely dim light for the workers. It must be remembered that during these times, the " safety lamps" used by miners had not been developed (Brunel Museum, n. d., p. 1).

The flooding was one of a number of stoppages that threatened to end the work at the tunnel. Isambard, in an attempt to show the strength of the works, even organized an extravagant dinner in the tunnel itself. However,

the stoppages ultimately took its toll on the finances of the project. To illustrate the point, the financial situation of the project was so dismal that construction was halted for seven years and the tunnel site was barricaded. When the project was restarted, the shield being used was much larger to encompass the 400 ft of the tunnel that was already excavated.

At the lowest point of the project, the tunnel was a mere 14ft under the River. When the tunnel was opened in 1843, it bore a horseshoe structure with the ceiling 23 feet high and an area of 37 feet. The total length of the project was more than 1, 500 feet. Though the tunnel was ultimately designed for pedestrian traffic, the project was ultimately sold to the railway networks and integrated as a part of the London Underground in 1865. It still performs this function up to this day (IK Brunel, n. d., p. 1).

The “ stunt” accomplished its objective. The “ Coldstream Guards” were performing in the background, and a number of distinguished guests were at the banquet- including the Duke of Wellington, a longtime supporter of the Brunels. The stock of the project was restored and the work continued. The newly minted confidence, withal, will be short lived. A breach in the tunnel soon inundated the tunnel, engulfing Isambard and others in the tunnel. The power of the water in the tunnel pummeled the men off the structures in the tunnel and destroyed the wooden framework where the bricklayers were stationed.

The rampaging torrent of water swirled the men and the materials in the tunnel like dolls. Isambard managed to wriggle free of the toppled scaffolding. After the flooding had dissipated, Isambard was able to survey the damage and concluded that the tunnel suffered a major breach. The



flooding had catastrophic impacts on the tunnel. Not only did the breach inflict greater damage than prior ones, the breach temporarily sidelined Isambard, Marc's greatest "asset."

Isambard's knee was badly damaged and suffered from extensive trauma; unknown to the younger Brunel, Isambard was suffering from internal bleeding. Isambard even wanted to remain on site and survey the damage via a "diving bell." However, even Isambard's ability to pull off daunting feats of mettle had its limits; Isambard was sent to Brighton and then to Bristol to recover (London Reconnections, 2014, p. 1).

Even though Isambard has barely come out of the adolescent years, the younger Brunel soon became the father's representative at the work site. The Thames Tunnel project was where Isambard carefully honed his trade, and it was also here where Isambard displayed his tenacity and creativity for moving large works forward. By the first part of 1827, the Thames tunnel had lurched about 300 ft. The distance moved by the tunnel mechanism was a significant feat with the condition of the terrain at the site, the water as well as the deteriorating air quality.

However, the progress made by the tunnel was extremely lagging. At this stage, the project was acutely behind schedule and losing money to overhead costs. The company's board of directors ordered that the wages of the workers be slashed to try and lower the expenses of the company.

Withal, the policy resulted in more damage than benefit, and even though the policy was revoked, the anger of the workers was expressed in a strike that stopped the work at the tunnel for a spell. In addition, the directors ordered, over Brunel's objections, to open the project to the public for the

price of one shilling per viewing.

Brunel objected to the policy directive owing to concerns over safety at the site. Brunel insisted that as the tunnel lengthened, the threat of flooding would be heightened considerably. In addition, Brunel believed that the tunnel shaft would be perilously close to the riverbed's nadir; by May, the fear was actualized when the workers in the tunnel soon started finding bits of coal and china in the seepages. This suggested to Brunel that the shaft was potentially closer to the bed of the Thames than was proposed.

Marc led Lady Raffles and her entourage through the tunnel on one of the guided tours implemented by the directors when Brunel suddenly felt a sense of intense danger. During the tour, the ceiling of the tunnel was punctured as the tide in the river rose. When the water finally broke, Isambard and the laborers with him escaped through the shaft at Rotherhithe.

After the flooding, Isambard went down into the inundated shaft on a borrowed diving bell to assess the damage. The cause of the flooding had soon become known; gravel excavators that were operating in the Thames had illegally dredged deeper than what was allowed by law. The tunnel did lay closer to the bed of the Thames than what was designed for, and the incident led to the collapse of the tunnel's ceiling. Though the damage to the tunnel could be remediated, ill tidings would still impact the father. Under the meticulous supervision of Isambard, the workers laid down rails across the gap and had bags of earth heaped on them.

When this was finished, the water was pumped from the tunnel; though the water was all pumped out, the flood left the air quality in the tunnel worse

than it was before. The poorer air quality severely impacted Marc's fragile health, and soon suffered a massive stroke. The flooding in the tunnel has resulted in decreasing levels of confidence in the project from the public. Given the fragile financial position of the project, the waning confidence of the public was potentially devastating for the project proponents (London Reconnections, 2014, p. 1).

Just as the work had resumed, the finances of the project was reaching its breaking point. The company overseeing the project was in dire need of investments just to sustain its operations; however, even with the tireless efforts of Marc and the Duke of Wellington publicly declaring support for the project, a fund raising effort failed to meet the requirements. On the 9th of August 1828, the tunnel was sealed, seemingly pointing to a demise of the project. The elder Brunel had other plans, though.

In the wake of the work stoppage, Brunel initiated a dogged offensive to secure the needed investments to complete the project, estimated at £ 250,000. Brunel solicited financiers and entrepreneurs but soon acknowledged that the only stable source of funding for the project was to apply with the government. Interestingly, Brunel discovered that in 1830, the government had also come to the same result earlier and offered funding to the company but was rejected by the former Chair of the company. The following year, Brunel had succeeded in remediating the damage, and though the elder Brunel suffered a heart attack, and coordinated with the government, allowing Brunel to get the funds from the Treasury. Nevertheless, convincing the Treasury to agree to the loan was another matter.

The initial loan application was rejected; nevertheless, Brunel continued to

lobby for the project. The second application was approved; however, the funding never came as the allocation for the Treasury Loan Scheme, the instrument that should have provided the needed funds, was similarly reduced, rendering it unable to allocate funds to Brunel's project. Three years later and a third application rejection, several Royal Society Fellows wanted to throw Brunel a dinner in his honor. During the dinner at the Spreadingeagle and Crown Pub, or the present day Mayflower, the group honored Brunel and established the "Tunnel Club"-an advocacy group focused in helping Brunel actualizes his funding needs. In June 1834, Parliament agreed to allocate £ 270, 000 in funding allocation to Brunel (London Reconnections, 2014, p. 1).

In 1843, the Thames Tunnel finally opened. However, the tunnel only served foot traffic or pedestrians; carts and horses were not allowed into the tunnel. This was due to the fact that the delays in the construction of the tunnel drained the tunnel's funding to construct the needed shafts with spiral slopes the horses and the carts can use in going up and down the tunnel. In 1865, the East London Railway purchased the tunnel with the goal of excavating new tunnel systems top connect the North and South of the tunnel and connect these to the national rail system. The year 1869 saw the initial train running through the tunnel that was originally designed for carts and horses. Here, the tunnel was finally doing what it was set out to do-facilitate the transportation of goods across the Thames. A century later, the line is now part of the London Overground, with Brunel's tunnel the latest component of the rail system in London (Brunel Museum, n. d., p. 1).

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