

## A SCHEME FOR BUILDING A BRIDGE OVER THE RIVER SUIR AT THE CITY OF WATERFORD

The use of BRIDGES in general, are so well known to be a public good, and so convenient to mankind for passing dangerous and unfordable Rivers, that it needs taking up no time to enlarge thereon: But of all that have yet been made for that purpose, there are few or none that require it more than the Bridge under our present consideration. The vast improvement it must bring on the face of this Country, and that improvement attended with an increase of Trade, and consequently an increase of Public Revenue, cannot but induce the well-disposed that are in power and interest to contribute all they can to carry so useful an undertaking into execution. Distant countries must taste of this benefit; and as Mr. Rolt in his Dictionary on Trade, speaking, of the Commerce of the City of London truly says, " That there is not an acre of land in the country; be it never so distant, that is not in some degree bettered by the Growth, Trade, and Riches, of that City."

The best place for building a Bridge over the River Suire at Waterford is, in my opinion, at the upper end of the New-Quay, at the place commonly called the Graving-bank; and where some time ago a bank of gravel had been run out a considerable way into the River; which, as I have been told hath since been reduced by lighters for ballast; and from thence to the opposite shore which happens to be a large abutment of Rock. The foundings here in the deepest part of the Channel at low-water spring tide, is fifty three feet, and that happens to be nearest to the opposite shore; and the foundings from thirty one feet to fifty feet, takes up about one third part of the breadth of the River at this place.

There are many shallower places in the Channel from this depth opposite the Graving-bank, to the Ring Tower; which takes in the extent of the Quay, and runs from forty seven feet to twenty four feet: And opposite Mr. Paul's, to near the Ring-Tower it sounds but eighteen feet at low-water. It may be advanced, why a Bridge may not be founded in some of those shallower waters; and several have mentioned to have it at the Fish-house opposite Barronstrand-Street, and that it would be more convenient to the Town: And by opening the narrow part of this street to Broad-Street, would make a fine and commodious street from the Bridge to John-Street. The situation of it comes nearest, as that of Caple-Street to Essex-Bridge in Dublin. At this place, in the deepest part at low water is twenty six feet. But, it is to be considered, that building of a Bridge here, would not permit a ship to come higher than the Lower-ferry ship, by which means the best half of one of the finest Quays in Europe, would be rendered useless for the lading and unloading of shipping. Otherwise, by making good the Quay up to the Bridge at the upper place, there might from thence to the extent of the Quay down, three hundred ships be safely and commodiously arranged: And for the conveniency, it will not take above five minutes to walk moderately from the Bridge at the upper place thro' King-Street and little Barron strand-Street, to the Cross, being the center of the City, and the most public market place in it. It is also to be considered, the additional expense of building the Bridge here; the River being two hundred feet wider at this place then at the Graving-bank, which is about one third more of the Rivers breadth; and consequently will take up one third more in money; above ten thousand, pounds to add to the Estimate.

It may be argued, that the city may extend itself, by making of Quays, and building of merchants dwelling-houses; warehouses and other conveniences, down the River.

To execute such a project, must take a great deal of money: The expense of building Quays and houses, must fall on the industry of the Merchants. particularly those, who are, by building a Bridge at the Fish-house, excluded from their proper share of the Quay, and thereby routed from their present settled habitations. Beside, the consequence of taking fifty or sixty thousand Pounds from trade, to be employed in buildings immediately for the reception of those, who must quit the conveniences they have on that account, and possibly to their hurt, by laying a part of their Capitals out in this manner; and thereby sinking what should extend them in their businesses. Hereafter, on the increase of trade and inhabitants, may give a latitude to Building; but it will never answer for the present.

To obviate this, it may be observed, that a Draw-Bridge might be contrived at the center Arch; or at some other of the Arches, to let masted ships pass to the upper Quay; and that Draw Bridges have been made to London Bridge, and to Thomond Bridge at Limerick, and at other places for that purpose; particularly to the former.

Draw-Bridges, are generally constructed to Garrisons and Forts; to secure the entrance into them, and are drawn up in the night time; or in times of a siege, and on many other occasions. But a Draw-Bridge fixed on any part of this, must be very inconvenient; as well as a weakening to the Bridge; for, in whatsoever place it is contrived, I may say, that there, it cuts the Bridge into two parts, and divides the united strengthening of the arches to each other; and as there can be no middle stanchions to receive a double leafed fall, the single fall cannot be less than thirty feet wide, to let a vessel pass with her masts and yards; which latter must be trimmed fore and aft, without the benefit of her canvass to help her on :-And should

the ship happen to hitch or entangle herself in her progress through, the danger is, that by the rising of the Tide, either the Bridge or the Ship must receive damage; or possibly both.

These kind of Bridges, are best where narrow Channels are filled with tides; as may be observed in the city of Corke, to let vessels pass to the Quays and warehouses, and where a turning Bridge is constructed that takes the full breadth of the Canal; and through which ships may be safely wharfed by the Quays on each side. The same kinds are used for passages over the Canals in Inland navigations.

The Draw-bridge at Bristol over the River Avon, could not be avoided, as a passage at that place, was necessary for a communication from the City, to an improved and extensive suburb; - Beside, the principle on which that Bridge is built, differs much from what could be practiced here. The River there is very narrow, and but one arch way that receives the fall, which gives an opportunity for wharfing and guiding a ship with safety; and no danger of a suction from any other arches: And with all this advantage, it is well known, what a vast trouble and interruption there is, both to ships and foot-passengers, at the time a ship is passing there.

The Draw-bridge to London Bridge, was found to be so troublesome, to the concourse of people that daily passed that way; that to discontinue it, was more eligible than any conveniency it could give to let masted vessels pass. And that at Limerick was found to retard passengers from passing through that great thoroughfare, and therefore was closed up; tho' its original use was for the security of the garrison, as the Rivet is navigable but a small way above it.

There are many other Bridges, whose draw arches have been disused for the same reasons: and would certainly be in time the case here, as being inconvenient to passengers, and also to ships who would chuse lying safe below Bridge, than venture through a Draw-bridge with a chance of danger; by not having the conveniency of wharfing, and possibly missing their stays by the suction of the neighbouring arches. Therefore to avoid all these inconveniencies, or hazard of danger that may happen; it is best to erect the Bridge in the place I have mentioned, where no Draw-bridge is requisite.

There are few places in this Kingdom better laid out by nature for trade, than the City of Waterford; and it only wants this one projection of Art, to make it the best in the kingdom. -No Port has the advantage of carriage by water more, and no Port the advantage by land carriage, less. From the conflux of the River Suire, Nore and Barrow into its Harbour, renders the carriage by water, cheap and commodious to, and from many of the Inland counties of the Kingdom; and will the more so when the navigation of the Nore is compleated. But for the want of a passage by land carriage, a great part of the Trade, which its situation has laid it happily out for, is impeded, and consequently many other disadvantageous incidents attend it.- The principal export Trade of this City, hath been for there many years pass chiefly, in Beef, Pork and Butter; and those are commodities that are mostly brought here, from other counties; that have not the advantage of water carriage, and if they had, the commodity of Beef, in which may be included Hides and Tallow, are inconvenient to be brought by water; but are generally drove by Land. And in driving those useful and beneficial creatures to our markets; just at the door thereof through which they are to enter, Behold! there is a full stop made: they must be battered and drove into a Ferryboat; fretting and wasting themselves, while they are bound down with rings and ropes to secure them. The young wellfed beast will not comply to this usage, but often plunges out into the tide, and after a long drift way up stream or down stream as the current answers; the fatigued creature is with much difficulty got to land. What relief then can there be, for what is so prejudicial to the trader, but a BRIDGE.

By compleating such a work, the advantages must be an increase of the Beef, Pork and Butter trade, an addition of Corn, Hides, Tallow, and Leather, and many other useful Commodities; by which every individual would in some measure profit. And beside that part of the county of Waterford, that lies contiguous to the City; the counties of Kilkenny, Carlow, such part of the County of Tipperary as lies east of Carrick. The county of Wexford, Kildare, the King and Queen's Counties must, by opening such a market, have greater demands for those commodities on which the riches of those counties depend; and of course, add much to the sale of cattle, at the great Fairs of Ballinasloe and Banagher; as they are situate contiguous to those different counties. And the addition of other commodities, that may in time arise from those Inland parts, namely, Oak, Coals, Wool, Cheese, Rapeseed. Marble, Bark, &c. as are yet unseen to us, must augment our export manufactories; so that what by the advantage of our water carriage, and this of our land carriage, we shall be able with our exports, to vie with foreign competitors in any foreign market, and thereby assist the Domestic manufactories, subject to export in the whole kingdom.

If every Sea Port in it met with proper encouragement; to the increase of their trade and manufactories, by removing those obstructions that commonly prevent an extension thereof, there would not be a more happy nation; for its situation and growth in the Universe. To the North quarter of it, every encouragement to be given to augment their Linen, lawn, and Flax manufactories; already so happily patronized by the goodness of Parliament and the Linen Board. The South, for their manufactories of Beef, Pork, Butter &c. exported to the West Indies, France, Spain, and their Newfoundland trade. The East, for the encouragement of their great importations; particularly the Metropolis, whose concourse of shipping is great; trading for a share of all the goods manufactured throughout the world: yet, its Harbour and Port exposed to many difficulties; notwithstanding the great improvements made to secure it. If there

were numbers, of Docks and Piers made convenient at the shores, which are dangerous in bad weather for some leagues on each side, they would contribute vastly to the safety of exports as well as imports, that constantly throng in, and bring their Riches into that Harbour. And the West, (quite neglected) for a fishing Trade of Cod, Ling, Herring, and every other fort that is known to be in the Seas, together with the Sunfish, Grampus, and others of the Cetaceous kind. A proper encouragement in this Quarter would make an appearance on their shores, like a Newfoundland and a Greenland: But laying aside digression; let us come to the point in hand.

By such a Conveniency, it will cause our Merchants to speculate on many matters, that now cannot occur to them; and open many scenes of Trade that now lies in oblivion. It will contribute, to the detection of a Counterband Trade; that pernicious and wicked practice; so prejudicial to the fair Trader; by having an easy and ready passage over the River, for his Majesty's Officers of the Revenue; who are often delayed on their informations by Ferry-boats; and smugglers have it much in their power to give this delay; for they may bribe ferry-men who ply in the boats, and who are generally such as a trifle can buy to do any thing of the kind; to delay and make excuses, and so prevent the officer for hours together from doing his duty, while the smuggler escapes with his booty, to the manifest hurt of the Revenue and Trade in general. Add, by this passage the advantage of our Post coming to us at times by some hours earlier then it does, to the great benefit of Businesses, and the dispatch of many transactions attending it.

The Port of the City of Waterford is considerably ranked, the third Port for Trade in the Kingdom. Its Revenue for Imports, Exports, and Inland Excise, has been for some Years past, Sixty Thousand Pounds yearly and upwards, and appears still to be on the increase. From such a considerable annual Revenue, it must naturally follow, That the Merchants are active, as well as extensive in Trade, and deserve every encouragement that tend to the increase thereof. That they are also fair Traders; and as such, a set of the most useful Men to the welfare of Society. Thus, from the increase of Trade, many thousands more to the Revenue, may be accumulated.

There are more Ships sent from this Port yearly to Newfoundland, then are sent from all the other Ports in the Kingdom; as the Banks of Newfoundland are inexhaustible for Fish, and that Fishery unrivalled by any other Nation. It draws that Trade to the Catholic Countries; from whence we draw chiefly Money to our West India Islands; and from thence their commodities to us; which of late has caused a great importation; particularly Rum, through the proper channel of Trade into this Kingdom; And has much lessened the importation of French Wines and Spirits, and rendered, the produce of our Colonies cheap, and of course the consumption thereof more: while the others stand up at a high price, above what the bulk of consumers can come at. Sure such a Trade ought therefore to be encouraged, and particularly in this City; that has so extensively laid itself out for it: And nothing can more amply contribute thereto, than this passage over the River for a greater supply of Provisions for that Trade, and what can in no manner affect any other Port, as Pork, the chief Provisions for it, is reared more in this Country than in any other part of Ireland and fitted for that Market: And also thereby the fore mentioned counties, will be so much profited by it.

When we consider, how often the Provisions of our Markets are raised to exorbitant prices, it requires our looking into the cause more minutely. And notwithstanding, they may be heightened by Forestallers and Hucksters, who will take every advantage of the most assiduous to suppress them; yet, not having a ready and easy passage to cross the River, the extraordinary expenses that attends getting over, inflames the price of those portable articles on the Consumer. The Countryman coming to Market with Provisions, meets a delay at the Slip of two or three hours. He refreshes himself, and charges the expense on the Commodity he brings. If the weather proves severe, and wind and current runs high together, he cannot get over at all in Market time; and often returns back with his Provisions, to the disappointment, of our Markets and the Seller, who has no other Market for fifteen Miles to apply to: And his disappointment, occasions a disappointment in the payment of his Rent, by which the Landlord suffers; whereas, if he had a ready passage over, he would trudge on to Market without delay, and vend his goods readier and cheaper than he can now afford it, and no disappointment attend.- This is a standing Tax upon our Provisions; and as Sir Mathew Decker justly observes on a similar occasion; That an additional Tax upon Leather of two pence per pound, makes the Vender of Shoes lay six pence extraordinary on the pair, tho' the pair should not weigh half a pound.

Had the City of Waterford been built on the County of Kilkenny side of the River, it would reap many advantages, that without a Bridge it cannot now enjoy; and a Ferry might answer the purpose of whatever Trade, might arise from its own County; that part of which that lies most convenient to it to supply it with provisions, happening to be some of the coarsest, and most uncultivated part of the whole. Nor indeed, can the cultivation of the whole County, fully supply this City Market; with the other Market towns that are in it: If so, what a scarcely must the Markets of the City be subject to, if they had not those resources in the adjacent Counties, And what encouragement ought not there be given, to make those resources easy; that at the same time benefits the Country around it. The City of Waterford is large and populous; with generally a Regiment or more of Soldiery quartered there, and therefore requires large and well stored Markets to supply it. And whenever our Provisions are dear, we seldom find that it is so, from a scarcity

among our neighbours, but from the difficulty of bringing it to our Markets. And should not every evil be removed that occasions the like in a Populous, Trading and Manufacturing City, the increase of which, and every other of the kind, must add new acquisitions to the whole Kingdom. Also to be considered, the damages often done to Carriages and Cattle, by endeavouring to get them into a Ferryboat. Gentlemen, should have their Horses taught the manage of this part of Horsemanship; how to leap into it, as Chargers are brought to stand fire, to save them from the accidents that often happen.

Whatever may be the advantage or interest of a few Individuals, it is an unreasonable objection to be made, against carrying a Work of such public Utility into execution. It will not take much argument I believe, to persuade, even the most ignorant, that a Bridge over a River, is more preferable than a Ferry; and that the driving of a number of Cattle and Carriages over a Bridge, is much more safer and expeditious, than the putting them into a Ferry-boat. I need not therefore insist on the conveniency of the one, and the inconveniency of the other; only to add, that a person must ride twenty-five Miles, who is unwilling to Venture himself on the water; to get by means of Bridges from the other side of the River, to this, and if he happens to be at Ballyhack, which is reckoned but five Miles from Waterford, he must travel, mostly a bad Road, near seventy miles before he can get to this City. -So bounded are we with Rivers, that surely an undertaking of this kind, will be; If I may be allowed the thought, forming an Isthmus, to join an Island to the Continent and thereby, not improperly; a link to Human Society.

The Ferries of Waterford and Granny are those only that will be affected by this Work; and it is to be presumed, that the Proprietors will shew their titles, the damages they sustain, and the intrusion that will be made upon them. I apprehend the latter can make no claim of the kind, as it lies about a Mile and half above the City, but the former will be sensibly affected by it.

On admitting the Utility of a Bridge over this River, it will not be improper to mention the several kinds of Bridges, that are made over Rivers; and their different constructions, and what fort will be most fitting here, and the manner of constructing it.

From the concurring reports of many yet living, who have seen several pieces of framed Timber taken up from the bottom of the River, it is no way doubtful, but that a Wooden Bridge was formerly opposite Mr. Strangman's on the upper Quay, to the other side at the Black Slip. It is said to have been built by the Danes, when they inhabited Ireland. - The depth at low water is twenty-seven feet, the difference between high and low water is sixteen feet, and some tides eighteen. -And admitting that ten feet was fixed in the bed of the River, the length of the main Standards must be fifty-five feet, to which must be added eight feet, for upper Standards. For such a length, the square could not be less than three feet at the head, and to diminish to about two feet, at the lower end. As in those days, the Country entire was a Grove of Oak, what in this time is very scarce, and any length might be had for it. - The scantling of the longest piece of Timber, in the Bridge made by Caefar over the Rhine, is proportioned by Palladio at forty feet, and two feet square; and his Standards, as they stood inclining to the course of the River, at eighteen inches square : So that those Standards, by the same proportion, could not exceed thirty feet in length. Thus, by Palladio's proportion, the main Timbers of the Bridge of the Suire, could not be less than two feet six inches square. -But, as it is admitted that a Bridge was over this River, we must also admit that the square was too small for the lengths, by which the whole went sooner to decay. Such is the consequence of most of the Wooden Bridges that have been built for public use, and those that remain in private places, are generally in shallower waters, and well attended to in their repairs. There are none now standing in this Kingdom, but what are in a dangerous way; and the expense that attends keeping them up from time to time, would have built Stone ones in their room; particularly that over the Black Water at Caperquin in this Kingdom. From what is before observed, the attempting to build a Wooden Bridge, (which had been thought of by some) over this River, at the place most convenient for it, would be as idle, as it is impracticable. -Batty Langley in the year One Thousand Seven Hundred and Thirty eight, drew two designs of Wooden Bridges for Westminster; but as he says himself, " Believing that Interest was predominant to real merit, he declined troubling the Commissioners with it." -In which he did right, for I think it would be a pity, it should take place of the Noble Structure, that now is there.

Pontoon Bridges, or what is commonly called a Bridge of Boats, may come next under our consideration. This fort cannot be deemed more than temporary, thrown across Rivers on some particular emergency. They are very useful in an Army, where the crossing of Rivers is necessary for bringing over Artillery, Baggage and Troops, and are often taken up again as occasion requires. In other cases, they are thrown over narrow Rivers; as sometime ago at Kilkenny, when the two Stone Bridges of that City, were swept away by the Flood. At *Cobentz*, situate at the confluence of the *Rhine*, and *Mofelle*, there is a Bridge of Boats from that City to *Hermanflein* ; one of the strongest Citadels in Europe. But, as this part of the River is Navigable for large Ships, they have a method of letting slip; two or three of the boats in the middle to let the Ship pass, and make them fast again. It has been mentioned here of making a Bridge of Boats for this River: as if any other kind was impracticable, but, if it even was constructed, the uncertainty how long it would remain useful, is, what should be feared, being subject to so many accidents. Its length would occasion it to be moored, mostly from its Center; either to the Shore on each Side, or by strong Anchorage: and a constant Attendance ought to be at each end, to watch the Fastenings on the rise and fall

of the tides. The Navigation up the River, would be quite obstructed even to the smallest Craft, by the beams that must be framed from pontoon to pontoon; unless that troublesome method at *Coblentz* was practiced, which; as it gave a passage by Water, must greatly obstruct the passage by Land.

Palladio, in accounting for the Origin of Bridges says; " At first, men made Bridges of Wood as having a regard only to their present necessity; but, when they began to think of immortalizing their Names, and that their minds were enlarged by riches, and furnished with conveniences for attempting greater matters, they began also to make Bridges of Stone which are more durable and expensive, as well as more Glorious for the Builders of them."

This great Architect, has given us some fine Drawings; as well of some of the Bridges of the Ancients, as those of his own designing; and the Ingenious Inigo Jones, in his notes on Palladio, confirms the ornamented parts of them. He highly recommends that at *Ariminum* a City of the *Flaminian* Tribe: and which he believes to have been built by Augustus Casar. The length of the Bridge from butment to butment, is one hundred and fifty-nine feet, and the breadth from out to out, twenty-nine feet. It contains five semicircular Arches. The three center ones are of equal dimensions, and twenty-five feet each in wideners. The two end ones, twenty feet each. The Piers; which he calls Pilasters, are eleven feet thick. I am the more particular in giving the dimensions of this Bridge, on account of shewing the great difference, in the Magnificence and Ornament of the Modern ones, to that of the Ancients. Palladio, speaks of this Bridge thus, " But seeing of all the Bridges that I have observed; that appears to me, to be the finest and the most worthy of consideration, as well for the strength, as the compartment of it.". He further says. " That quite the length of the Bridge, there is a Cornice, which; altho' it be plain, adds nevertheless a most agreeable ornament to the whole." From the high character this great Master gives of this Bridge, and yet the poor dimensions, and ornaments of it, what are we to Judge of those Bridges in Ancient History, so highly extolled by the Greeks and Romans. If Palladio had lived in the present Age, how contemptible in his eyes, would those Bridges look that are built over the Tyber, to those that are now built over the Thames. It appears by Palladio's own designs of Bridges, that he was not so well pleased with the poor dimensions that the Ancients gave them. In the eleventh plate of his third Book, he proposes at Bridge of three Segment Arches, over a River of one hundred and eighty feet wide. The center Arch he makes sixty feet the other two forty eight feet each. The Piers, twelve feet thick; but still retains the error of the Ancients in the breadth; which he makes but thirty feet from out to out. The Piers seem to be too slender for the Arches; yet, as they are but in seven feet of water, and their height, from their foundation to the Spring of the Arch twelve feet, may be considered, as very sufficient. In his Ornaments, he has followed that of *Ariminum*. I cannot omit speaking, of a Grand Design of his, which he says he drew, for one of the greatest and most Celebrated Cities in Italy, and Trading to almost all the parts of the World. He is silent in naming the place, yet I take it to be Venice, and on the site where the Riotta now stands.<sup>1</sup> The Conveniency, Grandeur, and Elegance of this design, is much to be admired. It contains three semicircular Arches, highly ornamented. The Porticos, Galleries, Columns, Inter-columns, and Pilasters, are all of the Corinthian Order. Variety of Statues, on their proper Pedestals, beautifully arranged, heighten the view. In short, the whole confirms you, in the great judgment, of the masterly hand that designed it; and it shews, that it was a favourite of his own, when his first words in speaking of it, are, "Very fine, in my Opinion, is the design of the following Bridge." – To which may be added, "That it is a great pity it was not carried into execution. We are beholden to James Leoni, an eminent Architect, for a most elegant Edition of this great Mans Works, with the Engravings, by Picart; and also, the notes on him, by Inigo Jones; which otherwise might have lain unnoticed, in Worcester College.

He has also given us a Drawing of a three arched Bridge, at Vicenza; (the place of his nativity) partly Ancient, and partly Modern; or rather an Ancient one revived. The Center Arch is thirty feet; by which we may observe, that the Ancients were timorous in making large Arches over their Rivers, which they did not spare doing to their Aqueducts, as they were commonly built on dry ground.

There are several fine Bridges over the Rhine, and other Rivers in France and Germany: But the advantage is great, in founding Bridges over fresh water Rivers, to that of tide Rivers. The former, are generally shallow, and made so by the rapidity of the current running always one way; which commonly washes off the Oozy, or soft Substances, that may lie on the surface of stony, or hard gravelly bottoms; and generally leaves the River, crossways, level. It often happens to be an easy matter, particularly in a dry season, to divert the water through one half of the channel, while the other half is building. In the latter, there is daily a flux of water, in many places, from fourteen to eighteen feet, beside the depth below low water; which renders the founding of a Bridge, more difficult and expensive, and the greater caution should be used by the Projector.

---

<sup>1</sup> The Riotta, is a single segment Arch, over the Great Canal at the City of Venice, Ninety-eight English feet and half, from butment to butment; allowed to be built by Michael Angelo, in the Year One Thousand Five Hundred and Ninety-one. Palladio lived prior to that date; was born in Vicenza, a Town belonging to the Republic of Venice. He flourished in the Fifteenth Century, and died in the year one thousand five hundred and eighty. So that this design might have been for Venice, in whose territory he was born, and was at that time one of the greatest, and most flourishing Cities in Italy. Scamozzi laid two designs for this Bridge before the Senate: one of three Arches, and the other of one large Arch.

Having made some particular observations on the Bridges of the Ancients, let us now come nearer home, and consider those that have been executed in our own Kingdoms.

We find, before the building of London Bridge with Stone, a Wooden Bridge was made there, sometime between the years Nine Hundred and Ninety-three, and One Thousand and Sixteen, after Anlaf the Dane had sailed up the Thames with a Fleet of Ninetythree Ships, as far as Stanes: And ravaged the Country on each side of the River, -Ethelred was then King; who with the Citizens of London, from a political view as well as a passage over the River, built this Bridge to prevent the Danes, from any such excursions again. But the constant repairs and expense that attended it, put them upon building it with Stone: And about the Year One Thousand One Hundred and Seventy-six, the same was begun under the direction of Peter a Clergyman, Curate of Cole-church; and in those days of great reputation, for his skill in Architecture. But Peter, not living to finish this tedious and great undertaking, by a Royal Letter in the Year, One Thousand Two Hundred and Two, from King John to the Mayor and Citizens of London, recommending Ifenbert another Clergyman, Master of the Schools of *Xainctes*; to be Architect and Surveyor to the same, and who had constructed the Eridges of *Xainctes* and *Rochelle*. And three Years before it was finished, we find, the same King taking away the custody of London Bridge from the Mayor and Citizens, and granting it to Friar Weft. -From the time of the beginning of this Bridge, under the direction of Peter of Colechurch, to the finishing it under Friar Weft, was Thirty-three Years. -The charges of building this Bridge, was not near that of building a modern one; notwithstanding the length of time it took, as Materials were easily got, and labour very cheap. The Subscriptions for building it were low; for we find the Archbishop of Canterbury, gave only a Thousand Marks; which is Six Hundred and Sixty-six Pounds Thirteen Shillings and Three-pence Sterling towards it. There is a Vulgar Notion that London Bridge was founded on *Woolpacks*, but this mistake, as Mr. Maitland observes, probably arose from a Tax upon Wool, towards its construction; and further adds "Be that as it will, it was certainly built at the charge of the Public, by whom, and the profits of the Houses built thereon, the considerable Benefactions and Toll thereof, it has for many Years supported itself without the least charge to the Public."

The real foundation of this Bridge, are Stilts, or Piles of Oak and Elm, shod with Iron and drove into the Ground as far as they can be, and as close together, and cut off about Low Water Mark. And on the heads of those Piles, a platform of Oak, ten inches thick was fixed, and the Stone Work laid thereon. -Around this foundation of Wood, are other Piles drove, which rise to the heights of High Water Mark, known by the name of Sterlings, which close the Bed of the River to the Foundation Piles, and are for a defence to them against the violence of the Water, or any other matter that may come down the River to annoy them. As those outside ones decay, or are carried off, they are replaced by others; and by not finding proper births for them, among the Stumps that remain of those that are carried away, they drive numbers, far exceeding the original ones; so that the Sterlings put down by way of repair, have taken up a considerable part more of the Waterway. They also drive, what they call Driftshod Piles in the Lock or Water-way of every Arch, in order, the Ground should not be wore away from the Wooden part of the Piers: So that the water under all the Arches, is from three to ten feet deep, and the depths on the outside above and below Bridge in the deepest, is from seven-teen to twenty-three feet. These extraordinary depths, are occasioned by the falls of the Flux and Reflux through the Archway, with a Rapidity on each side; and closing up the Waterway in this manner, has occasioned, at some Courses of the Tide, to have near five feet for a Boat to jump through, and possibly striking those Drift-shod Piles that are in the Water-way, occasions many accidents to happen, at what they call Shooting the Bridge. The repairs of this Bridge have cost, for several years past Two Thousand Pounds a Year. The Bridges of Bristol, Berwick, Dresden, Prague and Ratisbon, are founded in this manner.

That great Architect Sir Christopher Wren; to whose Memory, Saint Pauls Church in London is a Monument, proposed an excellent Plan for the improvement of London Bridge; and the same was since laid, before a Committee of Bridge - house Lands at Guild-Hall, by Charles Labelye: Engineer of the Bridge, and Mr. Dance the City Surveyor, in the Year One Thousand Seven Hundred and Forty-six. The Plan was, That every third Pier should be taken away; which in Nineteen Piers, nine were to be removed, and the remainder well repaired; and to turn Gothic Arches from Pier to Pier; and by clearing away the Sterlings, Drift-shod Piles, and all other obstructions, would add above two third parts more to the Waterway, and there would not be above nine Inches of a Fall through the Arches; but this projection for that time was laid aside, and other repairs; with the removal of the Houses thereon, was agreed to.

In repairing of the Piles or Stilts, it has been observed, that a *Bitumen* or *Pitch* was found in the place of Cement. It is to be presumed that they thought this Material; as being of an unctious nature more lasting in the Water, than any other kind they had then in use.

The next Bridge well worth our Notice, is that Grand one built from Westminster, to the opposite Shore, across the River Thames.

Before I enter on the Founding and Finishing of this noble Structure, I beg leave to observe, that Mr. Ware, in his complete body of Architecture, {an excellent and useful Work} has given us a design of a Bridge, which the Title says, was intended for Westminster. - It contains but seven Segment Arches; and on my tracing it from its Scale, I find the three middle Arches to be equal at one Hundred feet each. They

diminish twenty feet in the next, and ten feet in the smallest. The Piers are equally proportioned, and all the Solids and Voids put together, amount only, to Seven Hundred and Twenty feet, which is Five Hundred and Fifty-three feet less than the present Bridge at Westminster. The depth, at deepest, from High Water to the Bed, is Twenty feet, and corresponds with the soundings at Westminster. But, as Mr. Ware, has not been particular in the Descriptions on any of his designs for Stone Bridges; except what he has taken from Palladio, and that the Sections differ so much, makes me certain, that this design was never intended for Westminster. The design is very elegant and well proportioned, and suited for whatever breadth of River it will answer. -I thought it proper, not to leave such a design unnoticed; lest the remarks I make might escape others who may view it, and who are not so far concerned in observing Errors of this kind, as I am at present.

In the Year One Thousand Seven Hundred and Thirtyfive, the Inhabitants of Westminster applied to Parliament to have this Bridge; which was granted to them, notwithstanding it met with great Opposition from several Petitions against it, by the City of London, Borough of Southwark, Company of Watermen, and the Westcountry Bargemen. After the Act past, divers projects for erecting it, were taken into consideration; and the following being judged the most eligible, the same was approved of by the Commissioners, and is as follows. -A large Hole or Cavity of five feet deep, was ordered to be dug in the Bed of the River; and levelled at the bottom by the Ballast Men belonging to Trinity-house. These Cavities were to be, where each Pier was to Stand: and a large wooden Case or Caisson made Water Proof, and sunk into the Cavity; and in this Frame, and on the bottom, was the Pier erected. The floor or bottom, is a strong Bed of Oak Timber of the same shape of the Pier; about Eighty feet long, Twenty-eight feet wide, and two feet thick. - When the Pier was erected, the sides of the Caisson were taken away and applied to another: And so on till the whole number of Piers were built. I should have observed, that there were Piles fixed without side the Caisson, to guide and secure it in its proper birth while it was sinking, and the Pier building; these were in length some feet above the highest water.

This Bridge is allowed to be one of the finest in the World; and built in a neat and elegant Taste. Its extent from wharf to wharf is, One Thousand Two Hundred and Twenty-three feet; which is above Three Hundred feet more than the breadth of the River at London Bridge. The length of every Pier cross ways, from point to point of their Cutwaters, is above Seventy feet; and each point terminates with a Salient right-angle, against either stream. It has fourteen Piers, and thirteen large, and two small Arches, all semi-circular; with two abutments. The Arches admit Eight Hundred and Seventy feet, free waterway, which is more than four times as much, of the free waterway, between the sterlings at London Bridge. The breadth of the Bridge is forty-four feet from out to out; in which there are two footways of about seven feet each, with fine recesses in the form of semi octangular Towers, and elegant Lamps finely constructed, and placed at convenient distances, on two fine ranges of Balustrades caped with neat entablatures. The carriage way is paved with a broad Moor Stone; and the breadth will admit; without any danger, three Carnages and two Horses to drive a-breast. The Piers are built of large massy blocks of Portland Stone quite thorough, as well jointed and cut as the outside. The Arches are of the same material, and their soffits cut and jointed as close as the fronts. The cement used in the joints is a Dutch Tarris, and they all cramped with Iron and secured with Lead; so contrived, as none of them are to be seen in the outside joints. Over the Arches, are counter Arches of what is called Purbeck Stone; four or five times thicker at the reins of the Arches, than at the crown; so calculated and built, that by the help of those secondary Arches, together with the incumbent load of materials, all the parts of every Arch are kept in Equilibrio, and each Arch can stand single, without affecting, or being affected by any of his fellow Arches, tho' even without this assistance, it is the nature of the semi-circular Arch to do so.

The center Arch is seventy six feet in the clear, and the others decrease equally on each side four feet, to the two Small Arches, near the abutments, Between every two Arches, a drain is managed to carry off the water and filth, which in time might penetrate, to the great detriment of the Arches; a caution seldom observed in the building of Bridges, for want of which, many of them have been ruined, and I doubt not, hastened on the destruction of the Ancient Bridges: As I never could learn this precaution, was in use among them. -From the time this Bridge was begun till it was finished, Notwithstanding many incidents happened, and delays of Materials, it was completed in Eleven Years and Nine Months, at the expense of Two hundred and Sixteen Thousand Four Hundred and Sixty Three Pounds, Ten Shillings. - Mr. Maitland lays down the Sums, by Grants from Parliament and Lottery Schemes, from the Year, One Thousand Seven Hundred and Thirty Seven, to One Thousand Seven Hundred and Forty Nine, to be absolutely granted in that time for building this Bridge, Three Hundred and Eighty Nine Thousand, Five Hundred Pounds.

This vast expense is easily accounted for when we consider the great price of the Materials, that this Bridge was built with. Portland Stone Brought by Sea and purchased by the Ton, or Cubical foot; the two middle Piers only, contained Three Thousand feet Solid. The great quantities of timber used in the Platforms, Centers and Caissons, the same Author tells us, that the Caisson in which the first Pier was Sunk, contained One Hundred and Fifty loads; which is about Seventy Five tons of timber. Also the outside Piles, the abundance of Scaffolding, and other Supernumary Poles, Spars, Scantjings, and Planks,

that must have attended so great an undertaking. The great quantity of purbeck Stone in the counter Arches; and their fillings of Masonry. The Iron and Lead for binding and cramping. The vast quantity of Bolts, Spikes, Nails, and other articles of Iron. The Tarris, and other Staunching contrivances: But above all, the expensive ornamented parts in Portland Stone; as the Balustrades with their Basis and Capings. The outside Entablatures, the recesses, the rusticated Ornaments to the rims the Arches, and to the different Angles on the Piers. The chamfered and plain Ashlar in the Piers, Soffits and Cores through the whole &c. together with the great length of the Bridge and the Wharfs at each end; must, even in the Workmanship alone, arise to a Great Sum, beside the Materials, and the great trouble and expense in laying them. All there properly considered, and the Superb work they made when they were put together, cannot much surprise us at the greatness of the Sum they came to; the bulk of which must: fall to the share of the upper Work; for all the uncertain or under Water-work was computed to be, but Forty Thousand pounds.

There is another stately Bridge since Built over the Thames, from Black-Friars in the City of London, to the opposite side in the County of Surry, nearly in the middle between the other two. Mr Edward Oakfey, in the Year, One Thousand Seven Hundred and Fifty Six, gave three fine drawings of Bridges for this place; one to be approved of for that purpose: But, as I find the first Stone of Black-friars Bridge, to be laid the Thirty First of October One Thousand Seven Hundred and Sixty, and Robert Mylne to be Architect, do apprehend Mr. Oakley was not concerned in it. His designs are all Segment Arches, and I am told that the Bridge that is made, are also Segment Arches. The drawing he recommended to be followed, has a fine Elevation, and contains Eleven Arches beautifully decorated. The center one is One Hundred feet wide, and I am informed the dimensions, both in Arches and Piers of the present Bridge, are the same of this design. The Section of the River here is One Thousand and Ninety feet; which is One Hundred and Thirty Three feet less then that at Westminster. The founding of this is, in the same manner, as described of the other. I find the depth here under low water to the bed of the River, to be Seven feet, and the difference between high and low- water, Twelve feet. As Westminster Bridge lies more up the River, the Soundings should be rather less, admitting the bed nearly level, and that of London Bridge; as it lies lower, be more, and so it is found. Samuel Decker of Walton Esq.; gave the City his opinion concerning the Bridge intended to be built at Black-Friars; recommending it of Stone like Westminster Bridge, and that the Center Arch be One Hundred feet wide, the next on each side Ninety, and so decreasing a tenth part to the smallest. He adds that a Bridge there like Westminster may be computed at One Hundred and Fifty Thousand pounds. In the Year One Thousand Seven Hundred and Fifty Four, there appeared a Scheme, for the better improvement of the City of London; And among other useful things that of a Bridge from Black Friars was much spoke to, and concluding says, " That building a Bridge there, would be considerably less chargeable, then that at Westminster, by reason of being shorter, and that several over fights in the other, may be avoided in this "

Effex Bridge in Dublin over the Liffey, is for its length a very fine one. In taking up the Old Bridge, the Piers were found to be laid on Oak platforms much decayed, and so slight as not to be sufficient to bear the weight of the Piers, and what must have occasioned the early ruin of that Bridge. There were Sterlings drove round the Piers, and repaired from time to time to secure the foundations. The New Bridge contains five Semi-circular Arches. The Center Arch Fifty feet, the length of the Bridge Two Hundred and Fifty feet; and Fifty one feet wide from out to out. This extraordinary wideness was given to answer the breath of Caple Street; as there was then a design projected, to open from the Bridge, the present Parliament Street, for the same wideness up to Dame Street to where, the Grand Structure of a Royal Exchange is now erecting. The Foundation of the Piers, were laid by means of a Coffer Dam; that is, a double range of Iron shod piles, drove length ways the River; in half the River's breadth, and for some space more, than would contain the breadth of the Bridge; and from each end, piles in the same manner continued slope ways, till they met the side of the bank. These piles were planked up within side, to above high water, and between the plankings, stratum of staunching Clay were, laid down, and well rammed to the full height. This occasioned a dry Dock or Dam for half the River's breadth, and for more than the breadth of the Bridge. It was first done at Caple Street side, while the full course of the River emptied itself on the other open half, on Effex-Street side. Notwithstanding this was done with great care and pains, it was found very difficult to keep the Dam Staunch from the leakage and soakings that got into it. Many were the contrivances that were made by Pump-works, Mills, and Cranks, to keep it free; and altho' Sundays and Nights, were not excluded from hard labour at it, it still had the Mastery. At length, several Screw or Barrel Pumps of the Dutch construction, over- came this difficulty, and they had liberty to lay the foundation of the Piers, and turned those Arches that could be done in the Dam, and then drew up the sloping wings, and turned them in the same manner to Effex Street side, letting the course of the River run through the Arches that were finished. And by this second construction of the Dam, completed the Bridge. This Coffer Dam cost Twelve Thousand pounds of the expense. The foundation is laid on a hard Stratum of Gravel that lies over the Rock. The piers and Arches are well done, with Mountain Stone of a lasting and gritty nature. There is a range of Balustrade on each side, properly decorated, with arched recesses on the Piers, and two flagged ways for foot passengers. The whole is strongly and elegantly executed; and an honour to the Architect who founded and finished it. The money raised for this work, was about Thirty



two Thousand Pounds. It met with great help from the Materials of the Old Bridge. As this Bridge is so well known among ourselves, I refer to those who have seen it; and have described the manner of its construction chiefly, as I must speak something thereto hereafter.

There is another neat Bridge of three Segment Arches, handsomely decorated, built over the same River; and now called the Queen's Bridge. It is built on the same side where Bridewell Bridge stood, which was carried away by the floods, in One Thousand Seven Hundred and Sixty-three, opposite the ends of Queen-Street and Dirty-Lane, Thomas-Street.

And now that the manner of constructing Bridges of most kinds, that are fit for Public use have been laid down: It will not be amiss to come to the point in hand, namely a Bridge over the River Suire, at the City of Waterford.

The first spoken to, was that of Wooden Bridges, and having allowed that a Bridge of the kind might have been over this River, let us see at this time how one of that sort may be founded. I have already mentioned, that it was facing Mr. Strangman's, to the opposite Shore, called the Black Slip; and in Twenty-seven feet Water low Tide. Also the largeness of the scantling, and the great lengths of Timber, that even in that depth must have been used, which in those days might be easily procured. – But as the most convenient place for a Bridge, to save and secure the Trading part of the Quay, is best to be at the Graving-Bank. We find the deepest part there at low Water, is Fifty-three feet, to this add Eighteen feet at highest, between high and low Water; and if the bottom will admit it, not less than fifteen feet can be in the Ground for such a length. From high Water to the Floor of the Bridge cannot be less than Ten feet. So, that to have main Standards in this part of the River for a Wooden Bridge, they must be Ninety-six feet in length, and if the square be proportioned thereto, you will not find Timbers for none but Oak ought to be used in England or Ireland to answer that purpose. And though it were even practicable, to get Timbers of that length and Scantling; the question is, by what Machinery they could be drove sufficiently into the Bed of the River. –No Standards that could be made after the manner of Masts for large Shipping, would answer; for the strength of such, are in the united elasticity of their Splicing and Fishing, assisted by the servage of Cordage generally laid around them. These have their repelling force in being upright; and from the trial of winds, are so many springs bound by those Bandages to repel: and more certain than a single Beam of that size; that may by some secret knot or fracture, yield to the impeling of that force, as often it has proved the case. –But take one of those artificial Beams; and drive it endways, as our Bridge Standard will require, and then all those Fishings and Splicings, must yield to a superior force of sudden Blows by driving, at their several artificial joints and bearings; what would not yield in the united and natural grain of a single piece, admitting that knots, or a private fracture were hid in it. –Beside, the decay of those Bandages in a short time under Water, which over Water are readily repaired. –The upright of a Mast may be called Yielding, but driving endways is conquered by Force. –I am particular in mentioning this, as it has been spoke of by some, that admitting a Wooden Bridge was to be made, the Standards might be formed in this manner. The great expense that must annually attend their repairs, should be sufficient to lay that thought aside.

Pontoon Bridges offers next. I apprehend, I have said enough already to make such a notion drop. It appears a kind of parallel to another strange notion, which I have been told was offered as practicable; in turning one arch from Bilberry Rock to the Hill on the other side. – Such an Arch, must be above Eight Hundred feet from Butment to Butment. The place lies about an English Mile above the City. How such a Scheme should meet with belief, must be from the most credulous; not considering the impossibility of framing a Center, for such an Arch; where many fathoms in depth of Water, runs beneath it. Indeed, we are told of strange Bridges in Romance, and this properly compared, is as Chimerical as the Copper Arch of *Salmoneus*, over which he rattled his Chariot, to imitate the Thunder of *Jupiter*.

The building of a Bridge upon Stilts or Piles like London Bridge, meets with the same difficulty of Pileing in deep Waters, and the same trouble, and expense of repairs the older it grows. We are assured the repairing London Bridge, is near Two Thousand Pounds annually; and those repairs, interrupting the course of the River, and making it dangerous. The method of Pileing is now mostly laid aside, and can be only useful in shallow still Waters, where the beds are not sufficient to sound Stone Piers on, without sinking a great depth.

The manner of founding the Bridges of Westminster and Black Friars, is certainly the best, when in a proper and manageable depth of Water. The preparing for the foundations, were by Ballasting Engines that worked in about Twenty-seven feet of Water at highest, and Eight or Ten feet at lowest; So that levelling of the Ground for the Floors was under their command. But, what Engine or Machine can be contrived, to level ground, or work for a foundation under water, seven or eight feet lower than fifty-three feet at lowest, and seventy-eight feet at highest. The Bag Pole<sup>2</sup> must at least be Ninety feet, and what single man could, as is the custom to do, or two men could they exercise it, work with such an Engine: Or if they could scratch away something from the bottom, it would become to tedious and trifling, as to render it useless. And if all that difficulty was overcome, and a Caisson fixed, and a proper foundation for it attained; yet, there must be a Pier built above Seventy feet high, before you come to spring the Arch. And it further happens here,

---

<sup>2</sup> The Pole to the netted Bag used in raising Ballast.

that the slightest Piers are to be in the deepest Water, as they are proportioned to the width of the Arch they support; and not to the depth of the Water they are founded in; and it is well known, that the shorter the Piers are, they are the stronger. It is found to be the best way, to range the foundations of Piers as near as possible to a level; and this has been observed at Westminster Bridge. What possibility is there of practicing that here, where the Bed of the River must be cut through about Forty feet deep, to bring the Piers at Thirteen feet water, level at their foundations with those at Fifty-three feet. If a Pier in the deep water, which must be seventy feet high, should happen to meet with an uneven foundation; from its slightness and extraordinary height, is in danger of falling, even before an Arch can be sprung; and in greater danger when the weight and thrust of the Arch comes upon it. -To proportion Piers by their depth of water, would be absurd, as well as an incumbrance: the former, by seeing a range of Piers three times the bulk in some, that are in others; and that mostly at one end of the Bridge; and the latter, by taking up, double or treble the water-way, they ought to take.

The manner of Essex Bridge as already offered, would never in the least answer for founding a Bridge over this River, even in the shallowest place: And it appears to me, to be the most difficult of any yet described. The Liffey is but a mere Brook in comparison to this River, for breadth and depth: The bed of the River is, high at the City of Dublin; as we see by the tide going up but a short way above it. So that its shallow water, and narrowness of the River, gave many advantages for conducting that Bridge by a Cofferdam. Such an attempt here would be attended with innumerable difficulties and incidents: The piling as before described, and staunching the banks between them. The many Springs that probably would fall in, beside the leakage and soakage, must render it nearly impossible by any means or contrivance to keep it free; an essay of this kind would, turn out a fruitless, and expensive attempt.

On the whole, it appears, that none of those methods generally practiced for building Stone Bridges, can, with any degree of certainty answer here. The next thing to be considered is, in what manner a foundation may be made with safety, to secure a strong and lasting Bridge over this River at the most convenient place, which, as hath been already spoke to, is at the Graving-bank, at the upper end of the New Quay.

The depth of water here at low ebb, as already mentioned, is fifty-three feet, and from this great depth, the only practicable method is, by raising a BANK to within five feet of low water at lowest, and then building the BRIDGE thereon. I am aware that a method of this kind, as it is new, may meet with many objections. But after I have laid down the manner, how I would have this Bank made, and the security of it, I hope to remove every objection that I think may be made to it from myself, and by every other person.

The materials that I would have used for this purpose, is rough quarry-stone, in as large blocks as can be managed; and quarry-shingle. Those when mixed together, will form by their own pressure and weight, a piece of ground of that stony substance, as will be equal to whatever of that kind is given us by Nature. It will be, if I may be allowed the expression, welding of Art upon Nature, as a piece of Steel is welded on Iron. And by being properly conducted, become one Compact piece of solidity with the ground on which it lies, that no force can disturb; but by time, instead of decaying, become more strong and irresistible Nature, may be imitated in her Rustic and massy state; and the Copy, at length Be taken for the Original. We have many in Stances of it in this Kingdom; where the ancient Hills and Forts that were then raised for the Purposes of those times, are now the children of Nature in density and use; and little known from her natural Offspring; than by some races of regularity, to shew that they once were the Works of ART.

The material for this Bank happens luckily to be near the place; a range of quarriable Rock, that affords great quantities of shingle, such as might be wished for the purpose. - After making the proper stations on the shores of each side, to shew the arrangement of the Bank; the River Boats or Lighters may be employed, to bring large quantities of this Stone and Shingle and exactly at the times of Still high and low water; which will let them fall perpendicularly, to throw them in: The largest Stones first; for the first Stratum of the Bank, and then other Stone and Shingle promiscuously, and by throwing it in at times together, will cause the shingle to intermix and bind, and fill up the Cavities among the Stone, by thus persevering, no doubt can arise but such a BANK may be completed, to whatever dimensions may be given. It will not be amiss to sink among them length ways here and there, several discharging pieces of timber, and also upright pieces, with their upper ends to be nearly to the Surface the Bank, as will best occur in carrying on the, work. Those will tie the Bank while it should remain in its loose state, till it makes its own proper settlements, and meet with that resistance on the bed of the River that will naturally attend it; Its own weight, as the bulk there of increases, win work to that resistance, and make every softer quality that it meets, yield to its gravitation; till it fixes itself upon a solidity, as dense as itself, and there firmly endure; begging the expression, As long, as the Sun and Moon endureth. -Sir Isaac Newton in his Mathematical Principles of Natural Philosophy, confirms this axiom, on the motive quantity of a Conripetal force. Book I defin. 8.

Let us now confider the dimensions proper for this Bank. The Bridge I lay out to be as broad as that at Westminster; which is Forty Four feet from the upright, with two feet more of the Piers to continue, and the Cut-waters, which are to terminate in a right angle, will project Ten feet each; so that by leaving the Bank three times the breadth of the Bridge; or rather less; One Hundred and Twenty Six feet on the surface, is a full sufficient breadth, to found the Piers upon, and leave a considerable part of the Bank on

each side to project beyond the Cut-waters and Platforms. The Surface of the Bank, as before mentioned, to be about Five feet below the level of Low-Water, and to slope on each side equal to the bed of the River. But as the water is of different depths, by keeping the surface of the Bank of an equal breadth, will occasion in the deepest part of the foundings, a much greater breadth on the bed of the River, than in the shallower parts: But the mean of this, is properly considered, in the estimate of the Bank.

A farther observation may be made on the sludge and mud; - or earthy particles, that will naturally settle by means of the eddies on each side of the Bank. That a quantity of this kind will settle, is by experience known among ourselves; and the causes of such settlement are Mathematically, accounted for, by an Ingenious Gentleman<sup>3</sup> in his Treatise on Inland Navigation so accurately, as to describe the angles they will form from the tendency of their own gravitation. From the top of the Bank to the bottom; enclosing it on both sides to a certain thickness, it is to be presumed this gift of Nature will accumulate; and strike into the crevices, and irregular faceings that may be on the slopes of the Bank; and so lodging itself, in time will become a strong binding cement, adding security to the strength of the Bank. - That the quality of this stuff is such, experience shews us on the Shores of the River, where quantities are dug up for different uses, and the under stratum is so tough and firm, that good round building bricks are made of it. This addition to the strength of the Bank must doubtless render it so Permanent and Secure, that neither force nor time, can disturb or shake it. The different lines of this Bank are expressed in the drawing, and references had to explain the same.

It may be offered, that the Current will fall close to the Slopes of the Bank, and prevent the settlements of mud before mentioned.

It is well known, that the Velocity of a Current, paling over any Body of Matter, will, at parting that Body, overshoot it by a considerable way; and the greater the Velocity, the greater will be extent be; and the space between the under Curve of the Current, (the surface thereof still maintaining its level,) and the sides of that Body; be they upright or aslope, will be charged with eddie waters, laden with those particles of Matter that gravitate, and form the Settlements of mud on each side. - The Demonstration is clear; and founded on the same Principle which we observe in horizontal Currents; where in passing projecting Points and piers as at our Quays, the eddies get into the shelter of those projections, and unlade them- selves of their burthen. - The difference only is, that the one is Vertical, and the other Horizontal, but both alike Trigonometrically Demonstrated. Indeed; if at any time there was only a foot or two in depth of water, to run over the Surface of the Bank, it might then creep or rill down the slopes of it; but can have no Analogy to the Velocity of a deep Body of Water.

In order to level those places in the Bank, where the Piers are to be built on, and for the Platforms that are to lie there; or to level the Whole face of the Bank, it will be proper, as well to try the density of it, that an Engine be made for letting those places, or the whole, and so contrived with a moveable frame, nearly of the construction of those for driving Piles. The Beaters to be of Oak of a large square, and a good length well bound with iron, to rise a considerable height, and by its own weight, or an additional if wanting, to strike upon the Bank. The frame may be made to rest upon two River Lighters, in which the contrivance for railing may be fixed, and the Beaters fall down between them; and there will float in the shallowest Waters that will be on the Bank. This Operation will be best per- formed at flat low water.

The platforms for building the Piers on, are to be of the soundest Oak tree from sap. - Their thicknesses cannot be less here, than at Westminster Bridge, which is two feet. They are to be Caissons, to above the height of high water. But, as the Caissons are not high, other methods may be contrived to direct them, without Piling in the Bank<sup>4</sup>. What answers for the largest Pier of this work; after the Pier is erected may be taken off and fixed for the others as they are built; and as all the platforms are to be of equal dimensions, the framing of them are best thus. -Two thicknesses of nine inches each, and not to exceed fifteen inches in breadth. The under floor of those beams to run crossways the stream, and the next or counter floor, to be fixed over length ways with the stream, which makes eighteen inches thick. As there will be headings the longest way, let them be spliced and broke, that is, not two headings together. Then over that, a floor of six inch plank. -All these well jointed, trunelled, and bolted together, must make a lasting and strong bed, to build the Pier upon. -Mr- Maitland tells us, in speaking of Westminster Bridge, " That such beds of Timber. which, (if found when laid and always kept wet) will not only remain round, but grow harder by time." An instance of this kind we have in this Kingdom, where Timbers that have lain, both Oak and Fir, for many Centuries in Moory Grounds, have been taken up quite fresh and round in their Timber parts, by

---

<sup>3</sup> Vallancey, on Inland Navigation, or the Art of making Rivers Navigable.

<sup>4</sup> Scamozzi, in his second method for laying foundations for Bridges says, "The way is, by sounding the River, levelling the Floor, and preparing a Grillage of Oak, strong, well pinn'd and bound fast together with Iron; and kept upon the surface of the water by large Hulks or Lighters, with Cables and other Machines, having a thick stratum of large Stones laid on this Frame of Timber; the Stones well cramped together, and the Joints filled with strong Padua Lime, Morter, Puzzoli Terrace, or Cement, and then letting them gently down to the Bed of the River, by proper Machines and Cables.

This was practiced at the port of Ostia, in the time of Claudius: And Dragnet Reys did the same at Constantinople, at the Stately Mosque he built in the sea. Hawksmoor.

being constantly wet, and only their sap decayed; when otherwise, we find that Timbers subject to wet and dry, decay fast, and has been the case in Wooden Bridges. - The pieces of framed Timber taken up out of this River, round and firm, within these forty years; as part of the Wooden Bridge is a further example; that had lain under water since the time of the Danes.

The Superstructure is what comes next under our consideration. I shall refer a good deal of this matter to the Plan, Elevation, and Sections, which explains the greater part of it. But, as there are several kinds of Arches constructed in building of Bridges, it is proper I should give my reasons, for preferring the Semi-circular to any other.

The Semicircular, the Segment, the Elliptical, the Gothic, the Flat or square Arch, are generally what are in use for bearing pressures, or resisting sudden and rolling weights, or force, that may urge their way on them, in other cases as well as Bridges. The square Arch is commonly used to entrances and windows in buildings; and to many of the old Bridges in this Kingdom are yet to be found; with the reserve of a small Curve, by way of adding some strength to the Arch, yet seemingly, as it they were not fond to give it more. The Bridge Architects of those days, could not be so ignorant, but they knew, that a greater Segment Arch must be much stronger, and from their aversion to the Semi-circular; which we scarce find in any of their Bridges, we may easily see their regards for the flatter Arches. In a Bridge of any length, they considered the ease both of themselves and their carriages; and to make their Bridges level with their Streets and Roads, made use of this Arch. -They made their Piers gross for strength, which took up a great space in the River, and as their Arches were narrow, they found the flat Arch in time of floods, to give a larger waterway, and still preserved the level of the Bridge to their Streets and Roads. - They yet added to this favourite custom, by making their Arches all of a size; and level: Thomond Bridge at Limerick, a very ancient one, is of this construction, with the old error in being narrow. -It contains, if I remember right, twenty-one Arches, all equal and of a small width. These kinds of Arches, are now quite exploded in Bridges.

The Gothic Arch, is of a very old construction; and used in all the ancient buildings. It is a strong Arch for fixed and heavy pressures but inconvenient in Bridges; as rising with its acute point high, above the Semi-circular. It is made by two long Radius's; being two Segments joined on the top, and foot with their other ends on their base. It has been used by the ancients, as at London Bridge, but rather low to what they practiced in their buildings. -Sir Christopher Wren, intended to follow the same in altering that Bridge.

The Elliptical, is a Semi-oval whose base is the length of the Oval, and the side makes the curve of the Arch. It is formed by three Radius's one for each end; and the center one. Tho' it is a favourite Arch with many Architects, yet I think it too weak for a Bridge. -The Crown is but the dawn of a Circle, supported by two short segments that it Buts against, and liable on a great thrust to yield. -It has a handsome aspect when decorated, but the beauty is much lost in an oblique view.

The Segment Arch, is any part of a Circle whose Chord is less than that of a Semi-circle, and there, are more or less, as the Architect thinks proper. They are commonly used in Bridges, particularly those, who have few Arches, and the River narrow; they not rising to high as the Semi-circular, and are the next to that for Strength.

But, of all the Arches fit for Bridges, that of the Semi-circular is best. - There are many useful properties attending it, in strength excelling every other kind; for the most judicious in these constructions allow, that that Arch whose Radius is shortest must be the strongest, and that is only in the Semi-circular. In this kind, should the next Arch that joins sink or fall, that still stands firm, and receives no hurt by the misfortune of his neighbour; while the Segment and Elliptical, by their pressure and dependance on each other will, in such a state co-operate in the misfortune, and stagger each others strength, as a falling Nine-pin does all the rest that stands in the Frame. It is chosen for its strength in Fortification, as in Magazines and other Casemates that lie exposed to Bombardment. And for its beauty when properly decorated, it looks, making bold with the comparison, like a Meridian Sun arrayed in its full lustre, while the Elliptical and Segment may be said to be, but peeping above the Horizon. -These are the reasons, why semi-circular Arches are, and should be used preferable to any other kind, particularly in Bridges.

The modern way of laying out a Bridge with a large Arch in the center, and lesser ones in proportion to the ends, is a vast addition to the strength of the whole. It makes it all appear, as one continued Arch, and by this gradual curve from Butment to Butment, gives strength to strength. -Palladio recommends this manner much, and we find after him, none of the Architects practiced the level method already spoke to.

It will not be improper here to mention something on the binding and securing of Piers, on which those Arches are to bear. For the Stones, that may be applied to make the Piers and Arches, it fortunately happens, that there is at a place called Granny, and within a Mile by water carriage to the place of the Bridge, a large Quarry of excellent found Lime-Stone, that for cutting and firmness, hath been often proved, and can afford blocks of any scantling. Admit the different Stratum of the Piers are ready for laying: It will be right to strengthen them with a groove Band of Iron; that is, to have a groove cut in each Stratum an inch and a half deep, and an inch width, all round the whole, and within eight inches of the outside edge; In this lodge a band of Iron very well fitted, which will project another Inch And half above, the surface of the Stone; and the other Stones or Stratum that comes over that, to be provided also with a groove, which is to receive the projecting Iron, and so on through all the Piers in their different Stratum.

Wherever the groove band joins, let it not be near a joint of the Stone. There should be Cramps also of different lengths, at certain distances from each other, or where the joints will be best consolidated; one end fastened to the groove band, and the other end with a turn or claw, all let in level to the stone; and the end with the claw fastened with lead, and lead run quite through the length of the Cramp. If lead was run along the groove band where vacancies appear, It will be best; Some dowls may be let in at certain joints, where the knees of the Piers turn to the cut-waters. The filling of the Piers must be done with cut Stone, well jointed, and banded to the outside, and all laid in Dutch Tarris; and no common Masonry or Rubble to fill them. -The Stratums of the Piers may be fitted on dry ground, and the joints marked to their proper places with their Iron works; so there will be nothing to do, but to bring them carefully to their births, and there secure Stratum by Stratum till all are done. -By carefully conducting them in this manner, each Pier will be as one solid piece, on the strength of which, the material strength of the whole depends; and the same care in constructing the Arches, will produce A BRIDGE that for duration, will vie with ages.

It is proper here to mention the conveniences that are to be on the Bridge, for Passengers, Carriages, &c. Leaving the Bridge forty-four feet from out to out as before observed; by allowing the Parapets each two feet thick, will leave a clear way of forty feet, and out of that, take one flagged footway of ten feet broad, will leave thirty feet of a paved way for Carriages, Quadrupeds, &c, which will admit of more than three Carriages to drive abreast. The flagged way for foot Passengers, to be inclosed with a range of upright Stones, about four feet high, and at six feet distance from each other, with bars of Iron let in from Stone to Stone, one bar to be on the top, and another to be about half way the height, to hinder Cattle from breaking in, with a falling Gate or Turnstile at each end. -As it is necessary for the safety of foot Passengers to have the footway thus inclosed; one large footway on the side near the City, will answer more convenient than two. -For should a person pass on, with a view to look for another, and both happen to take different foot-ways, on account of the inclosures they must walk about the length of the Bridge, before they can meet; or pass across and inconveniently climb the inclosure; when by meeting on one footway, removes the obstruction.

It will be proper to have lamps fixed on each side of this Bridge, and Watchmen to take care of it, to prevent Robberies, Riots, &c. from being committed, that too frequently happen on places of this kind; for which purpose a convenient House should be built at each end, as well for the Watchmen, as for those who may be appointed to collect Pontage thereon.

At present there needs no upper Ornaments or Head dress to adorn it, but a strong plain Parapet of clean Masonry, capt with a drip cut Stone, and the recesses the same. Ballustrades, Arched recesses, Entablatures, &c. may be the Work of a hereafter. The making Centers for the Arches, is a piece Of Carpentry that must be ingeniously conducted both for truth and strength, and on which a great deal depends. Also the Caissons, the Machinery for raising Weights, and laying them convenient to their affixments, with other things that must be under the same care; together, with the Stone-cutting by proper Molds and Bevels. The different parts at Masonry; especially the Sewers that are to Drain off the rains and filth from the Arches, with many other particulars, are to be the care of the Bridge Architect, and the different Mechanicks that are to be concerned. I shall refer those things to the happy time, when this BRIDGE may be put into Execution: As now treating on them, would swell this Work more Considerably, then what I first proposed.

What comes on next to consider; are the Several Objections that may be made to this Undertaking.

An objection has been talked of, that the building a Bridge over this River, will cause greater Eddies in the several Docks at the Quay, and consequently will cause greater quantities of Mud, to settle there.

I would be willing to know why; by building A Bridge here, Greater Eddies will come into the Docks then, than now. - At present every Tide That flows, fills the Docks with Eddie Waters, to Whatever height the Tide rises, and considerable Eddies play withoutside the Docks, as it is known, our Ferry-boats at strong Flux and Reflux ply in those Eddies, to get an advantage of the Current. Therefore, as we have not greater quantities of water, how can we have greater quantities of mud. It cannot be offered, that on account of the Bridge, the Tides will rise higher then at present. Tis known by experience, that they will rise no higher then the pleasure of the Ruling hand that guides them; and, that different winds; as Agents of that hand, have different operations on this flow of waters. The fluid Body still keeps its level, and the course is not changed but continues in the same Channel. The construction of the Bank, being to be some feet under low water, can never give any Opposition to the flow of the Tide; as the resistance is in no manner between low and high water. - How then can greater quantities of water, and consequently greater quantities of mud settle in our Docks, when it is evident the quantity of Super incumbent water is not to be found. -Beside, it is to a certainty, that the Eddies will be less, as the Velocity of the Current will be increased, by the Piers taking up so much of the Waterway; for the water will maintain its Equilibrium, by the same quantity running through a lesser space. But let us Suppose for Argument sake, that a, larger quantity of mud will settle in the Docks: What then is the relief but by building the Quays farther out to catch the Current more, in order to make the Eddies less; and the consequence is of making, what is already a fine Quay, a most Noble Grand one; and for the length of the upper Quay; or more as may

appear convenient, give an opportunity of a choice range of Ware houses next to the River to happily situated, both for the lading and unlading of Shipping, with proper Wharfs for the Occasion.

The fall of the rents of Land (that are now at A high rate) on the City side of the River, can be no objection at all. The building of a Bridge may, and will raise the price of Lands on the other side; and possibly for a considerable extent into the Country. But that will be owing to an increase of Trade and an increase of Inhabitants, and as this offers, the Land on the city side will still keep up, as they lie most contiguous to the bulk of the Citizens, who must have those Conveniences. The high price for Land is but for a few Acres in comparison; of Soil and Mealowing that lies near the city, and that is generally set to Gentlemen, who must have each a Field or two for the Conveniency of their Cattle. It is not known, that any Grazier or Dairy Man, will give Five, Six or Seven pounds an Acre in order to make the rent of it, and a profit for himself; there are removed to a greater distance, where Land is much cheaper; beside, there is scarce any at the dear Lands, but are set by Lease for many years to those Solvent Tenants, so, that be there a Bridge or not, the rents must be paid and no Land lord can be a Sufferer and at the time those Leases terminate by the increase of Trade and Inhabitants those Lands will stand Improved and built upon, and rather rise then fall in their Value.

The objection that many of the Citizens will remove their effects, and live on the other side, is rather a matter to be wished for, then offered as an objection: For what Merchant, or Trader, who is well settled on this side, will unsettle himself to go and live on the other. He must waite the building of several houses to fix himself. - The Establishment of Quays and another Conveniencies for the carrying on of Trade, with many other matters that attend it. It is most likely, the young Men that intend to begin Trade, may be the first Planters there. And whenever that happy time comes, I doubt not but the Inhabitants of that side, will be found to be Oppulent Denizens; who have removed themselves and their fortunes from other places, and settled there.

When the first Bridge was built over the Liffey At Dublin, it is not to be presumed, that the Citizens murmured at it, because their Neighbours found it Convenient to inhabit on the other Side. On the contrary, we find that the great increase of Trade and Inhabitants in that City, is owing to the many Bridges built over the River; and occasioned that extensive Suburb, that now flourishes on the other side of the Water; which never would have answered that Noble Purpose, had their passages over the River, been confined to Ferry-boats. And what will make Southwark another great City in time, but the Bridges that are now over the Thames. It is to be hoped, that the time will Come, when an Inhabitant of the City of Waterford, who will remove from thence to live at the other Side, that his removal will be looked upon in the same light, as a Merchant in Dublin who removes from Essex-Street to Ormond Quay; where it makes no alteration, but leaves him still a Fellow Trader, and a Citizen of the same City.

Another Objection has been offered, that the Navigation the River will be Obstructed.

It is well known what kind of Craft ply above this City on the River. They are flat-bottomed boats, that carry from Fifteen to Twenty Tons; and the most Water they draw when loaded, does not exceed Four feet, made for the Shallow Shores and Pills that run into the River, and that carry up goods to the Towns of Clonmell and Carrick; for none other will answer the purpose. Then what Obstruction can those meet With not from the Bank, because there will be a foot or two of Water more, then the largest of them draws, at flat Low-water, and at a time, - when not a Boat of them on the River does move. The common Motion of those Boats are, at the times of flood and ebb, when the Current Carries them easily to the places they are bound to, and at that time there is a Sufficiency of Water for the large Keel Boat, to pass and repass the Bridge. If those Boats had not Water to let them pass, two or the next Arches might be left deep enough for that purpose, but I see no occasion even for that.

The place, now made use of for Graveing of Ships, must give place to the building of the Bridge. But there is a good Strand a little below the City; and near where a dry Dock had been erected, but now filled up: Here, as I am informed, was the place formerly for Graveing of Shipping, and it is very easy to remove it there again.

Another Objection hath been observed and looked upon as a Material one: That a Bank and a Bridge, according to the Construction I have offered, will cause a considerable fall at the Bridge; or more properly, throw the Water out of level by several feet, and what is called shooting of London Bridge, has been made use of as an Example.

I have already mentioned, that the Tides will keep their level in their progress, up and down the River. Indeed; if the Bank was to be raised above Low water there would be reason sufficient for this Objection, but as that is not the case, it must obviate every doubt about it. At flat Low-water there is a stillness on the Surface that at times scarce the winds do ruffle. The fluid motion ceases; unless what the freshes give, and even they, loose a great part of their Velocity by the stagnation of the other; how then can this great fall be at either ebb or flow when the water is no way pent up in its Course, but has a passage unless what the Piers of the Bridge may obstruct from High to Low-water, in which time the whole force of the Current is run, without a leap or bound in the Water, so much as to throw it any way out of level. <sup>5</sup> Rivers or Streams

---

<sup>5</sup> Inland Navigation on Rivers page V. from Mariette

that run free by, the uppermost part of the Water, go faster then that in the middle, and the middle faster, than that at the bottom. By this, the chief velocity of the Current, is above Low water, and being weaker towards the bottom cannot affect the surface so, as to unlevel it by any resistance it meets with below. -It may indeed, cause a Ripple on the face of the water, but nothing so uneven as to endanger, any thing floating on the Surface. -And also by the same principle, that the first and last of the Flux and Reflux, being weaker, then at other times of the Tide; and not having the quantity of water to support the Equilibrium of weight or force, can- not affect or damage the Surface of the Bank, or endanger any part of its Materials; more especially near the Piers, as their parts of the Bank are sheltered from the Current, by the Eddies that they cause themselves in their rear; and their Platforms, that extend around the Basis of the Piers; for room to work in the Caissons ; about seven feet, being charged with large blocks of Stone for the height of their Basis, to a considerable way on the Bank, must secure the Piers and their Foundations, from any danger, that may be apprehended from the Current.

Under the Arches of all Bridges, the current is more rapid than above or below them, and that is owing to the voids given the water by the Piers of the Bridge; And at still high and low water, there is a stagnation till the current changes This appears in the Bridges of Westminster and Black-Friars, and every other on the same kind of waters, and of the same construction. It is very plain, by what I have already mentioned of London Bridge, that the fall, and the danger of shooting the Bridge, is owing to the multiplicity of Sterlings and drift-shod Piles that are constantly fixing there for the security of the foundations, some higher than high water, and the cross or drift shods above low water. This banks up the River between high and low water, and the water endeavouring to maintain its own equilibrium, that at certain times of flood and ebb causes, a dangerous leap for boats to venture through. I have mentioned the relief Sir Christopher Wren projected for it, which would have reduced that dangerous fall to nine inches, and properly accounts for the cause of it.

It may be an objection, that there is no precedent for founding a Bridge on a Bank. -I answer, nor is there a precedent for founding a Bridge in near seventy feet deep of water. -It is a question, whether there is a Bridge in that, depth of water in the known World. - Yet I have been well assured, that the Pier of Malaga, of an extensive length into the Sea, and in about sixty feet of water, is founded on a Bank made after the same manner, to secure the shipping in that Port; and keeps firmly off, a weighty and rolling Sea, that beats against it. -If such a Bank can bear such a resistance, with the weight of a solid Pier of Stone laid on it, what is there in nature can disturb another of the kind; made in quiet water, in comparison to that, sheltered with high lands Dear three parts round; and above thirteen miles from the Sea: A lambent tide, with respect to the tide at the Harbour's mouth, and a constant passage for the water over it, through the Arches of the Bridge; View the one, and view the other in idea and there can be no doubt for the security of this, for our BRIDGE. If there was a natural Bank there, it could not be objected against, but if an Artificial one can be made as secure; where then lies the difficulty; -I am well informed that there are several other Piers or Mules in the South of France, and in other parts of the Mediterranean in deep waters, built and founded on this principle; and what the French call Fond Purdue.

The overflowing of the Low Grounds may be obtruded as an objection.

This frequently happens in fresh water Rivers, as in the Shannon and other places, where heavy rains occasion mountain floods to fall into those Rivers, and overflow every Brook and Rill that Runs into them. The main Source is then filled up to a prodigious degree; and having not vent for those superincumbent waters, well themselves over the adjacent grounds that lie lower, than the surface of the flood. This also stands good, to small Brooks Or Pills, where the tide has an inlet, and being pent up by Wiers and Milldams, and with the fall of the fresh, the adjacent low Grounds must then suffer. But this cannot be the case, in a large, wide and open River, that receives a Tide in its Channel for above twenty-five miles; and having no other obstruction between high and low water, than, the Piers of a Bridge; no tide can be pent up there- by, that can in the lest be perceivable on so extensive a surface.

That a Bridge of this construction may be a Means of shallowing the River

This, may be understood, that by extraordinary settlements of Mud on the bed of the river, the River must be made shallower -The stuff of this kind that is supposed will lodge on each slope of the Bank, must rather decrease that article; more especially, as the Velocity of the current will rather increase through the Bridge, by the contraction of the water by the Piers; and what will remain over the gravitation on each slope of the Bank, must be hurried down with the current as usual, and the current will still maintain its course, with the usual friction on the bed of the River; carrying on the load of particles, till they are engulfed in the waters of many fathoms depth below the City; and so on to be disposed of, as at the present time they are.- I have already spoke, to the objection of Mud settling in the Docks at the Quay ; and if that objection be removed, it is hard to think that Mud will settle in the strength of the current. Having I hope obviated, all the objections that might be made, or could possibly occur to me. I now proceed to an explanation of the Plan. This Bridge is to contain nine Arches, fixed on eight Piers and two Butments. It solids, or water-way, is Four Hundred and Eighty-five feet, the Voids or Piers, One Hundred and Sixteen feet, making in all, Six Hundred and One feet. The Piers take up less than one fifth of the

extent. And the Piers of Westminster Bridge, takes up more then one third and half of the extent of the River.

The Center Arch is 65 feet, the next on each side is 60 feet, the next adjoining 55 feet, the next 50 feet, and the smallest is 45 feet, diminishing from the middle Arch each 5 feet. – The Center Piers are each 16 feet, thick, and diminishing a foot each to the smallest, which is 13 feet. – A B are the Butments, and 601 feet from each other. The Occult lines C D, are the marks of High and Low water at 16 feet. E F, the Bed of the River. F G, the depth of the Bank 48 feet. From the surface to Low water at D G is 5 feet. H I is the breadth of the Bridge from out to out, 44 feet. The Occult line at K, shews the footway of the Bridge 10 feet broad. L, is the Section through the center Arch. M N, is the surface of the Bank 126 feet, and at this place is 13 feet deep. N O shews the line of the Mud that may settle on the slopes of the Bank, whose angle is 158 degrees sufficient to answer the Gravitation of those light, and separated particles of Matter. P, a Section of the Bank in the deepest Water at F G, and is 48 feet deep, and throws an extended Basis at Q R of 240 feet. R S, shews the Mud on the bed, with the same degrees of Gravitation. T, expresses the range of parapets with the recesses over the Piers. At each end of the Bridge, I have placed a Small Building for the Convenience of Watchmen and Pontage gatherers, as well as for the beautiful termination of the Bridge. – On the City end thereof; between the Shore and the Butment, being on the ground between High and Low water, may be built two Small Arches of plain Masonry, to discharge the eddie water near the Shore; they will be dry at Low water. – No Arch of this kind can be fixed on the other side, as the deep water comes close to the Rock, that lies happily there for an Abutment.

And now to proceed on with the Estimate for this Work; which I have Calculated by the different Admeasurations that must attend it, and other experiments known from Works of the like nature .

Estimate.

Details	£. S. P.
To 15500 Lighter loads of stone and Quarry Shingle, including the work of Quarrying and Labourers, at 10s. per Load.	7750 00 00
To 73680 feet of Ashlar Stone cutting at 1s. 3d. per foot.	4605 00 00
To 2600 feet of Architreve to the Arches, at 1s. 8d., per foot.	216 13 4
To 1660 feet of double plinth, ath 1s. 6d. per foot	124 10 00
To 4980 feet of Dip Caping to the Parapets, at 1s. 4d. per foot.	332 00 00
To 175000 cubical feet of Stone, to be cut and fitted in the body of the Poers and Arches, at 8d. per foot.	5833 6 8
To 14875 perches of Masonry, at 5s. 6d. per perch,	4090 12 6
To 780 yards of strong thick flaging at 4s. 6d. per yars.	175 10 00
To 2666 yards of filling and paving, at 12d. per yard.	133 6 00
To 580 tons of Oak Timber for the Platforms, at 4l. 10s. per ton	2610 00 00
To 1300 tons of Red Fir Timber to the Centers, Caissons discharging pieces and other uses in the work, at 2l. 15s. per ton	3575 00 00
To iron-work and lead	800 00 00
To Carpenters work, Sawing &c,	2500 00 00
To extraordinary Boats and Labourers attending the work,	1000 00 00
To Quarrying Tools, Barrows,&c.	350 00 00
To Dutch Tarris for cementing the Cut work	300 00 00
To scaffolding Poles, Ropes, Planks, &c.	350 00 00
To Incedents and Contingent Charges.	2000 00 00
<b>Total</b>	£ 36745 18 6



Having made up the sum Total of the Estimate, the next consideration is, in what manner the Money for this work can be raised. The best method is by application to Parliament; whose sanction to this work must be obtained, and whose goodness, for the improvement of this Kingdom, is well known in every County in it. Then, by Subscriptions, by loans and by Lottery Schemes, as is practiced in other parts of the Kingdom, for raising money for public Works. The raising by Subscription, may be made easy to those who are not willing, to give in a sum at one payment by paying it annually. He who Subscribes Five Hundred Pounds, may pay it at One Hundred Pounds a Year in five Years, and a subscriber of Fifty Pounds, at Ten Pounds a Year and so on. I shall not take upon myself to proportion any Sum to any, or either of these ways for raising it, but beg leave to observe, that the Gentlemen of the neighbouring Counties are, for opulence, superior: for so much extent, to any part of the Kingdom, and as ready to promote Public Welfare and Utility. And it is not to be doubted, if this useful Work be carried into execution, but they will contribute largely. By which, and The Clemency of Parliament, this Bridge, may become in time a free Bridge to the Public; and the Public well reimbursed, for the expense and disappointments that they have met with, these some hundred years past, for the want thereof.

FINIS