The Great Wall of Pixham

The incredible story of how Nick & Annie are fighting the floods and winning!

Contents

Introduction

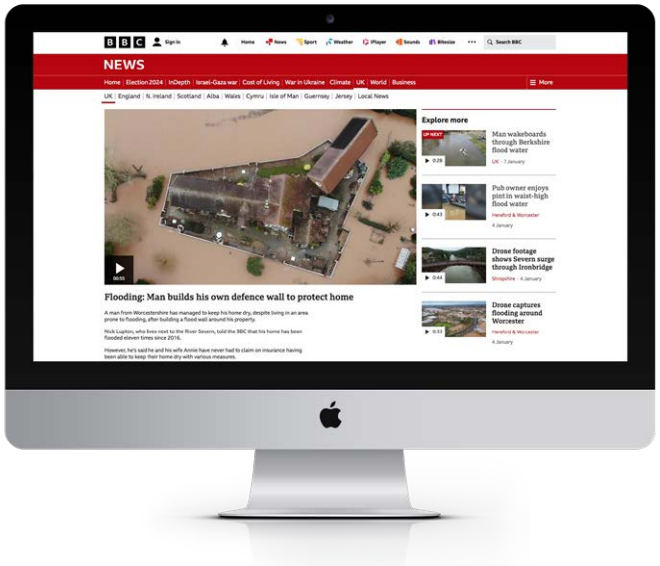
Nick and Annie Lupton

Following a BBC news story filmed during the January 2024 floods and the subsequent media interest in the flood defence wall we built, many people have been in touch, expressing interest in what we did and how we did it. They want to know what they need to consider to build a flood wall themselves. With that in mind, I decided to document what we did and the challenges we faced as a helpful guide from the perspective of a non-construction professional. Furthermore, what would we have done differently with the experience we have now? It is something I wish I had before we started, as it would have saved time, money and quite a bit of angst.

My aim with this booklet is to help others decide whether a wall is the right solution for their location or property. If it is, I want to provide guidance on what is needed to complete a significant project to protect your home. For us, I can comfortably say it has been a complete game changer. We went from holding back water at the exterior walls of the house to having a layer of dry land between the house and the wall. It wasn't cheap, but I consider it an investment that has added to the value and resale potential to our property. It protects the structure of the house in the long term and makes our lives more manageable during a flood.

As with most projects, there is a lot to consider: from obtaining consents, to design, project management, and the construction of the wall.

I hope this guide proves useful for those with little or no construction experience.



Watch the BBC interview ›

01 Pixham House, the story so far...

A brief history

We bought Pixham House in 2016, fully aware that the area was prone to flooding. To be honest, this is a house we couldn't have afforded if it were not at risk of flooding. It has four bedrooms, parts dating back to the mid-17th century, and a large garden of just under an acre. It is in a beautiful location, but it is in the middle of the River Severn flood plain.

The house has been around for 350 years and has a rich history. It has been a farmhouse, a pub, and a place where tenants of a nearby estate paid their rent, before becoming a family home around the 1970s.

Historically, the water was allowed to enter the property when the river flooded, with valuable items simply moved upstairs. Flooding was much less frequent, occurring about once every ten years. Our builder, Roger, shared an account from his grandmother, who lived in the house in the early 1900s when it was a pub. She said they knew a flood was starting when the beer barrels bumped on the underside of the sitting room floor as the cellar flooded.

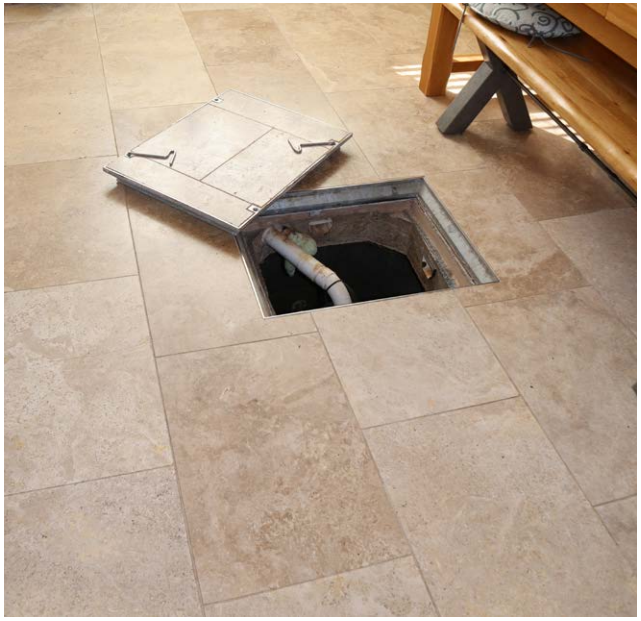
A brief history continued...

The original main part of this historic house was built in 1650 and has had two subsequent extensions; one built around 150 years ago and a more recent addition in the 1980s.

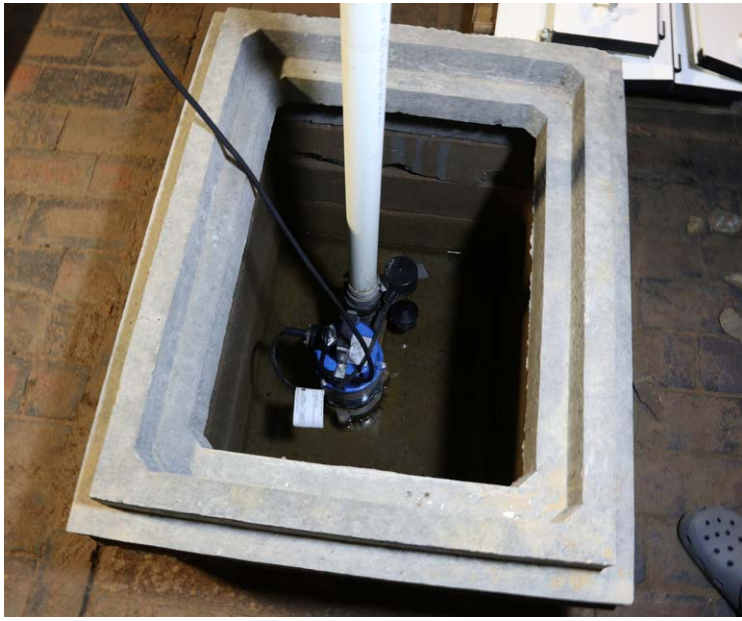
What flood mitigation measures were already in place?

We were very aware of the flood risk, as the previous owner had been open about it. He had experienced flooding during the summer floods of 2007 while undertaking extensive renovations to the property. Since the house was already stripped down to bare walls and floors at the time, it was easier for him to decide to fit flood mitigations. To his credit, he had extensive flood protection equipment installed, including:

- The house was tanked. The main part of the house with a cavity membrane system, which allows any water that comes through the walls to go behind the plaster and into the sump.
- Three submersible sump pumps are installed in chambers one meter below the floors, all interlinked with pipework.
- Two further pumps are located in the cellar.
- Stone floors throughout the house.
- All plug sockets were raised from floor level to above windowsill height.
- Flood barriers are fitted to the doors.
- Non-return valves are installed in the sewage lines.
- An LPG backup generator provides enough power to run the pumps during a power cut, installed after a power cut during floods in 2014.



Three submersible sump pumps installed in chambers below the floors, all are interlinked with pipework.



Two more pumps in the cellar.

Further resilience measures we made

My background is as a Chartered Mechanical Engineer, with most of my career spent working on power stations. I am very familiar with using and operating pumps and sumps, albeit on a much larger scale. It was my judgement that these systems installed in the house would do the job of flood management. So, we took the plunge (excuse the pun) and bought the house.

My wife Annie and I had three years with no floods, but then in late 2019, we experienced our first flood, and it hasn't really stopped since! We have become keen watchers of the river level gauges and now know when to start preparing for a flood. I am very pleased to report my pre-purchase judgement was right, and the installed systems worked very well. Despite having over ten floods (prior to the wall) we have never had to claim on insurance as we have largely kept the water out of the house. We have had some small amounts pass the door barriers, but this was relatively easy to deal with.

In mid-2020, we made use of a government grant to make further improvements:

- Air source heat pumps have been placed up away from flood risk.
- Secondary flood barriers have been fitted to the front of the porches.
- Puddle pumps are placed between the two sets of barriers to manage any water ingress into the porch.
- Absorbent cushions help soak up any small amounts of water that gets in.

Secondary flood barriers have been fitted to the front of the porches.

- A pond vacuum has been very useful, as it has two separate chambers; one is automatically emptied, while the other can continue working.
- We keep bees and lift the hives onto nine breeze blocks, which keep the bees and their hives clear of the water.

The river water at the bottom of our garden is over head height, and floodwater surrounds the property for several days.

These additional measures have reduced the small amount of water seeping in when a flood strikes. However, this hasn't eliminated it entirely, as we have found that water will find a way. The only thing to do is manage the situation in the best possible way.

Puddle pumps are placed between the two sets of barriers which manages any water ingress into the porch.

A brief history continued...

Air source heat pumps have been placed up away from flood risk.

LPG Backup generator, strong enough to run the pumps during a power cut.

02 What we need is a wall!

Why a flood wall?

In the last 15 years, following the extensive flood defence work completed, the house walls have been holding the water back. Although the walls are very thick, they were never designed for this purpose.

Furthermore, the foundations are not like modern concrete foundations. With the increased frequency of flooding, our fear was, in the long term, that the house would start to suffer structurally.

Therefore, we made the decision to build a wall around the house , for several reasons:

- The primary reason was to protect the house from any long-term adverse effects of having water so close to it.
- It provides protection from a bigger flood, accommodating around 30cm above the record flood in February 2020, which was close to breaching our previous mitigations.
- It offers another layer of protection, supplementing the existing house barriers that can still be deployed.
- There was also the aspect of making life a lot easier for us during a flood. There is considerable comfort and convenience in having a dry land barrier around the house, allowing us to walk freely around the property during a flood.

At the time of writing, the wall has withstood three floods in the winter of 2023/2024, and we're pleased to say it has worked exceptionally well.

How do we start?

This was the part I found hardest: where to begin? For us, the process grew organically from the initial concept of wanting a wall. We had to determine if it would actually work for us, how high it needed to be, where would it run, and where the openings should be for least disruption.

Remember that, outside of floods, the garden and the property need to function normally. Would the wall feel oppressive, giving a feeling of being imprisoned, and ruining the view? Or could it be seen as a courtyard or cottage garden, a cosy addition to the property? Building a wall is a major disruption, turning your property and garden into a construction site for a time and taking years for the garden to recover. Considering the project as a blank canvas and an opportunity helped us come to terms with these facts.

In our case, there was at least six months of prevarication. This time was valuable in visualising and testing ideas, understanding what would work and what would be a complete 'no-no'. It allowed us to see the opportunities of restructuring the garden rather than just the downside of digging large parts of it up. It made the whole project more exciting and easier to sell to ourselves. Once the wall is built, it cannot be moved, so time spent at the concept stage is important.

What really helped us was seeing that a couple of other people in the area had already built flood walls. They were more than happy for us to look at their designs, which helped us adapt the concept to our particular situation. Every property is different, so no two walls will be the same.

The other walls had been almost entirely put together by the builders employed for the job. Each had come up with a slightly different approach to the design and build. However, the common factor was a strong reinforced concrete foundation.

The different designs we considered were:

- Double masonry walls with rebar mesh infill and concrete poured in the middle.
- Hollow concrete blocks with vertical rebar and concrete poured into the gaps in the blocks.
- Temporary shuttering and pouring concrete to give a solid wall with no bricks or blocks.

You will see my solution turned out to be a combination of all of these methods.
We used a product called '**Stepoc'**, a concrete block shuttering system. It is a little more expensive than traditional concrete blocks but cheaper than temporary shuttering and pouring concrete.

More on this later...

Permissions and consents

There may be several issues to consider when building near a river, especially regarding any adverse effects on your neighbours.

Your local council may need to grant permission due to the height of the wall or proximity to other buildings or roads. Structural consents might be required to ensure compliance with building regulations, and of course the Environment Agency may be interested if work is close to a river. Additionally, consider if your property is listed, in an area of outstanding natural beauty, or of archaeological interest. Every project will have different issues to consider depending on the particular circumstances and location.

It is important that your neighbours are not negatively affected by your wall, either visually or by flood water being diverted and increasing their flood risk. The regulations are in place to ensure potential issues are considered and accounted for. Regarding the structure of the wall, it must be strong enough to withstand the weight of the water, so there may be building regulations relevant to your wall design.

In our case, we applied for a pre-planning consultation, which most councils offer for a small fee. This indicated that we did not require planning permission, as the wall is less than two meters high and more than two meters from the road. The river is over 100 meters away, and the flood bank slightly less than that, so we were well outside the distance where permission is needed for working on or close to a river. This pre-planning advice was reassuring, but it took significantly longer than the council's website suggested. A few weeks ended up being six months, and we had already started work. After multiple follow-ups, we had given up on the council. Therefore, getting this in early will save any issues when you are ready to begin the build.

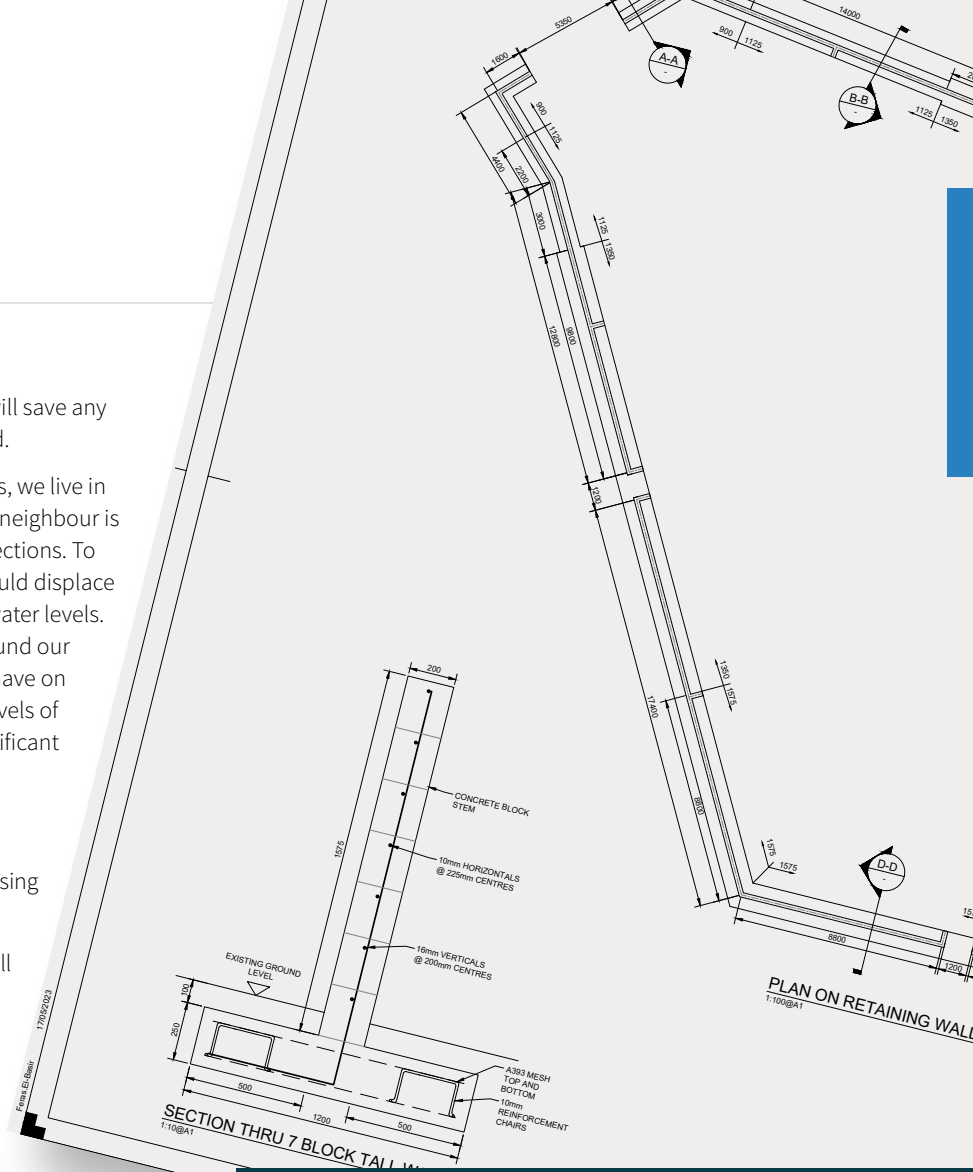
Regarding our work affecting our neighbours, we live in the middle of a flood plain, and our nearest neighbour is over 500 meters away, so there were no objections. To be sure, I estimated how much our work would displace water and affect the rest of the flood plain water levels. By estimating the area of the flood plan around our property and the reduction the wall would have on this area, I calculated an increase in flood levels of 0.04mm due to our development - an insignificant increase.

Key decisions...

To conclude, getting started involves addressing the following:

- **Feasibility:** Will the concept of a flood wall work for your property, considering the location, height of water, and services under the wall?
- **Impact:** How will it affect you and your family day-to-day?
- **Permissions:** Is it possible to build a wall in terms of obtaining permissions and consents, and how will it affect others?

Once you have considered these, the next stage is to think about the design and ensure the structure will stand up to the water pressure expected at your location.



Useful link

If you want a bit more information on consents, the flood consultants FPS Environmental produce an informative document regarding consents which is well worth a read fpsenvironmental.co.uk/building-a-wall-as-a-flood-defence

03 How did we go about designing the wall?

Now for the technical bit...

Designing the wall

Having decided to build the wall, where do we begin? This section is a step by step guide to how we approached it...

Level survey

The first physical action was to hire a laser survey tool to mark levels around the house and decide on the wall's height. It helped to have experience of previous floods and know the height of the biggest flood, which for us was in February 2020. To provide a margin of safety for an even bigger flood, we decided the wall should be at least 30cm higher than the February 2020 event. This may not seem like much, but in our area this represents a huge amount of water due to the size of the flood plain around us. This may not be relevant in all areas so height needs to be considered carefully. We could have gone higher, but too high would make the wall imposing, ruining the view from the garden and visa versa. Too low, and the wall could be breached in the future. In reality, the wall height was slightly higher than 30cm due to the coping stone on top..

To mark out the route, we put posts in the ground with string between them to give us an indication of what the wall might be like, using the laser to mark the heights, especially where it could potentially block a view. The house is on a slight slope, meaning the wall would be different heights relative to the ground as it goes around the house. The survey helped us understand where the stepped level changes were in the foundations, so we knew we would be building a wall of between four to seven blocks high (225mm each block, or 0.9 meters to 1.58 meters above the foundations). Above the ground, the wall appears

completely level. Below the ground, the foundations step up or down with the changes in ground level.

This initial survey and placing posts also helped decide where the openings in the wall might be, after all, we have to live with the wall everyday. We decided on four openings. Some locations were obvious, such as the front gate. The view of the garden from our sitting room was the main factor in another opening, where we decided on a large four meter opening to give the best view possible. A dam-board system is more expensive metre per metre than a wall and must be manually erected before a flood. So, the number of openings affects the cost of the wall and the work needed when preparing for a flood.

The survey was part of the process of coming to terms with the change a wall would impose. It helped us accept what would have to be moved in the garden and form ideas of what it might look like afterwards. We actually hired the laser twice. After a month of prevarication on the route and levels, we repeated the survey, mostly to confirm our ideas would work and partly to ensure we got the levels right the first time.

Read more about Laser levels ›

Then I started to think about what the structural design of the wall. One of my neighbours who had already built a wall recommended a document, which helped me to understand the options available and the engineering involved. It was from the US Army Corps of Engineers: "Retaining and Flood Walls." (see link below).

This weighty tome was daunting at first, but it provided a good understanding of the different options for a water-retaining wall. There may be further advice from the Institute of Civil Engineers or the Institute of Structural Engineers, but I must admit I didn't go that far.

The reading and internet research led me towards an inverted T-shaped wall, a wide but not particularly deep foundation that would overcome the flood water's forces pushing on the wall. My next move was to talk to a Structural Engineer, which was key in deciding the wall's structure. Although I used a Structural Engineer at this stage, in hindsight, consulting a designer first might have been a better idea. I will cover this shortly.

Useful link

One of my neighbours that had already built a flood wall recommended a document that helped me to understand the options available, and the engineering involved:

www.publications.usace.army.mil/portals/76/publications/engineermanuals/em_1110-2-2502.pdf

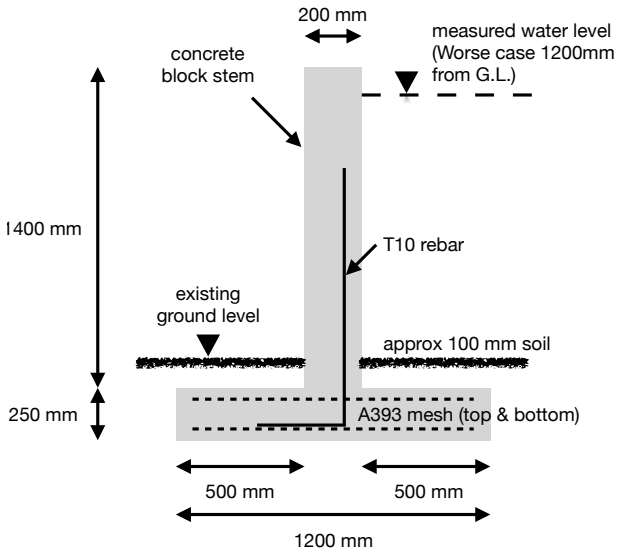
Structural Engineer

Once I knew the intended route and height of the wall, and had some design ideas regarding its structure and shape, my next step was to engage a Structural Engineer. This was achieved by an internet search, and by using the Institute of Structural Engineers' search facility.
The relevant qualifications are MIStructE (Member of the Institution of Structural Engineers) and CEng (Chartered Engineer).

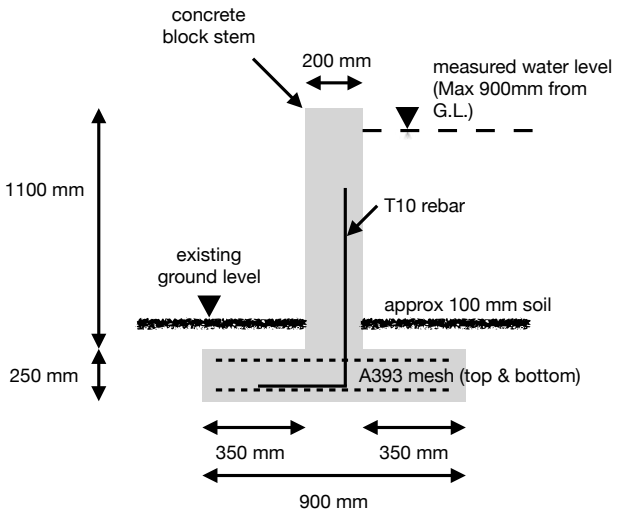
The Structural Engineer required information on the height of the water/wall, the construction material, and the soil type. To understand the soil type, we dug four holes about a meter deep where the wall would run (north, south, east and west), allowing the engineer to inspect the soil. We had a spectrum of soil types from sandy to clay. The engineer produced a document with many calculations, essentially providing a cross-section of the wall for two different heights.

During this stage, I was changing the materials we were going to use, so the calculations had to be adjusted several times, meaning an additional cost each time. Initially, I considered a double masonry wall with concrete in-fill, then a traditional hollow concrete block wall with concrete infill - see the diagram shown right for two different wall heights. The final decision was a **Stepoc** block wall, developed with the designer.

The Structural Engineer provided the basic design to ensure the structure would withstand the weight from the water. However, a lot more detail was needed to understand the bigger picture.



Retaining Wall. Type A Section



Retaining Wall. Type B Section

We needed to account for:

- The gaps in the wall
- The ground level changes across the site
- Thermal expansion
- The type of dam boards to be used
- What services run under the wall
- Specific factors such as proximity to trees potentially undermining the wall's foundations.

Useful link

The Institute of Structural Engineers has a search facility and the relevant qualifications are MIStructE (Member of the Institution of Structural Engineers) and CEng (Chartered Engineer).

www.istructe.org/find-an-engineer

Detailed Design

At this point, I had the good fortune of a friend's help. He is a director of an engineering company with a design section, and I was offered the services of a design engineer to help create a comprehensive design for the entire wall, including level changes, differing cross sections, and openings. This was a massive help in finalising the detail of the design, particularly for aligning the steel rebar for maximum structural strength.

This process also produced a **'Schedule of Steel'**, allowing me to order the steel reinforcing bar in bulk. This schedule detailed all the different vertical rebar shapes required and the lengths of horizontal rebar, enabling the steel to be bent and cut to the required lengths in the factory, saving significant on-site work. The design also clarified the construction process of the rebar, ensuring all steel was aligned for maximum strength and covered with concrete to prevent corrosion.

See example of a 'Schedule of Steel' ›

One seemingly minor but important consideration was the size of the bucket available on the digger. Matching the width of the foundation excavations to the digger bucket size makes the digging of the foundation much easier. I had to hire a larger grading bucket to dig the foundation efficiently.

In hindsight, it would have been better to consult a designer first rather than a structural engineer. A designer would have considered the entire project and then engaged a structural engineer to verify the design. So I had the cart before the horse to some extent. Although no harm was done, this approach might have saved some time and cost.

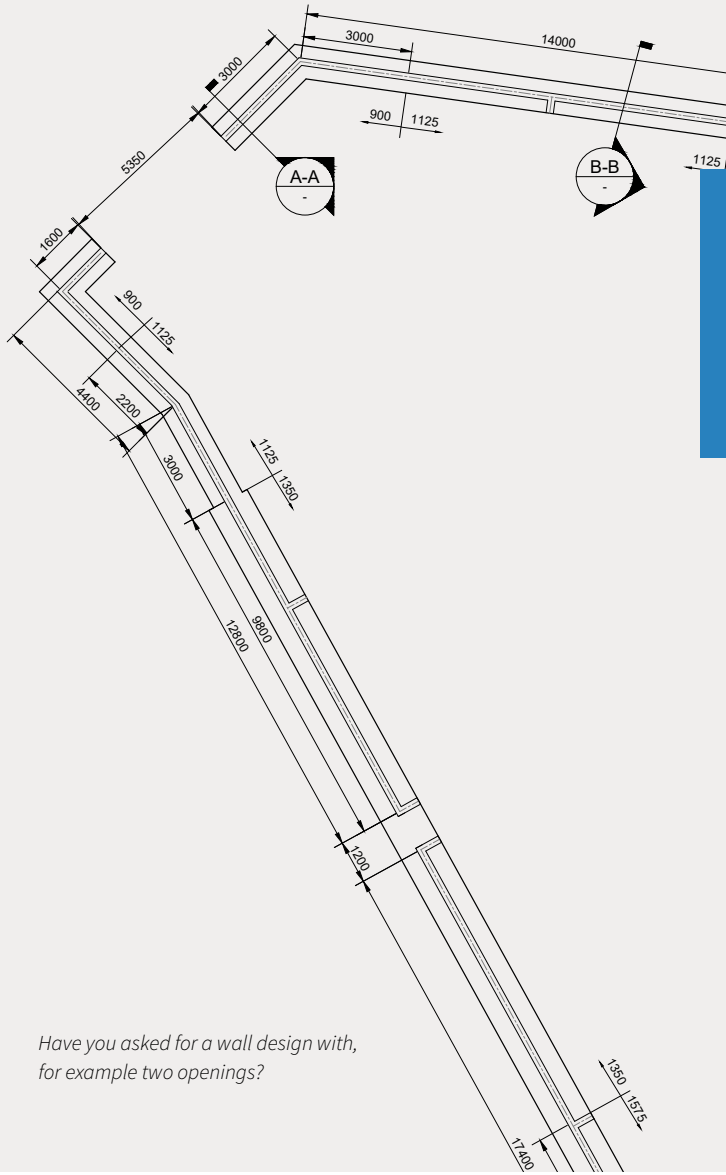
If I hadn't the good fortune to have a friend offer the design engineer's services, another option would have been with a company I found online called Retaining Wall Solutions.

This company helps create viable designs that suit your particular circumstances and provides both structural and detailed design elements. For instance, they suggested a deeper non-structural concrete 'curtain' to address my concern about water getting under the shallow foundation. Their experience with the **Stepoc** blocks and ongoing advice during the construction advice was invaluable, particularly for the final concrete pour.

If engaging a design consultant, my advice is to be very clear about your requirements and what you are paying for:

- Have you asked for a wall design with, for example, two openings?
- What materials are you using, masonry, concrete blocks or **Stepocs**?
- What kind of barrier are you using for the openings?
- What soil type do you have?
- Will they visit the site before producing the design?

This is not a definitive list, but missing details before you ask a designer to do the work will result in revisiting the design, which will incur additional costs. Preparations are so important, I didn't get it right the first time and consequently it cost more to revisit issues. Additionally, check what you receive from the designer to find any issues early and prevent delays during the construction phase.



Have you asked for a wall design with, for example two openings?

Useful link

Retaining Wall Solutions are able to provide the structural part of the design as well as a more detailed design.

retainingwallsolutions.co.uk

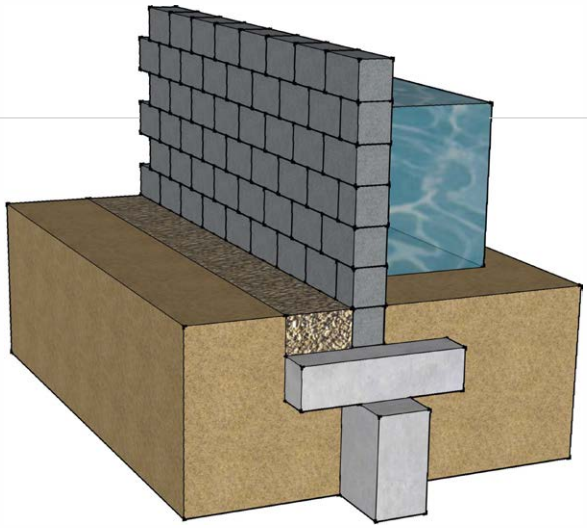
Ibstock
At the heart of building

Stepoc blocks

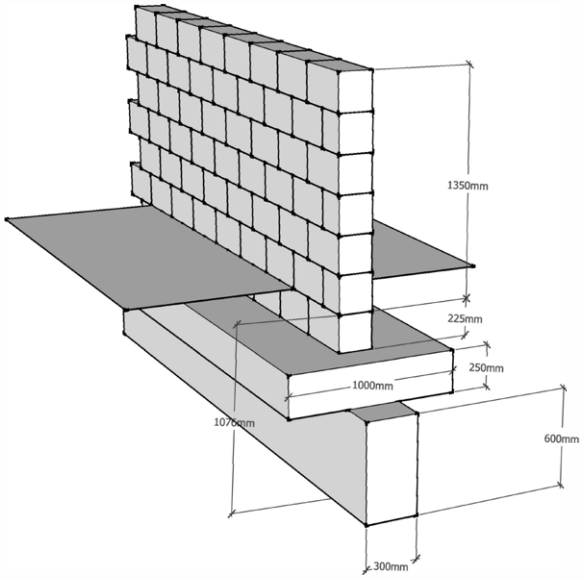
At this stage, you should now have a design for what you are going to build, a Schedule of Steel and a good idea on how many blocks you will need. If you are using **Stepoc** blocks they have a really useful calculator that gives you a good indication of how many blocks you need, depending on the number of corners, courses and openings.

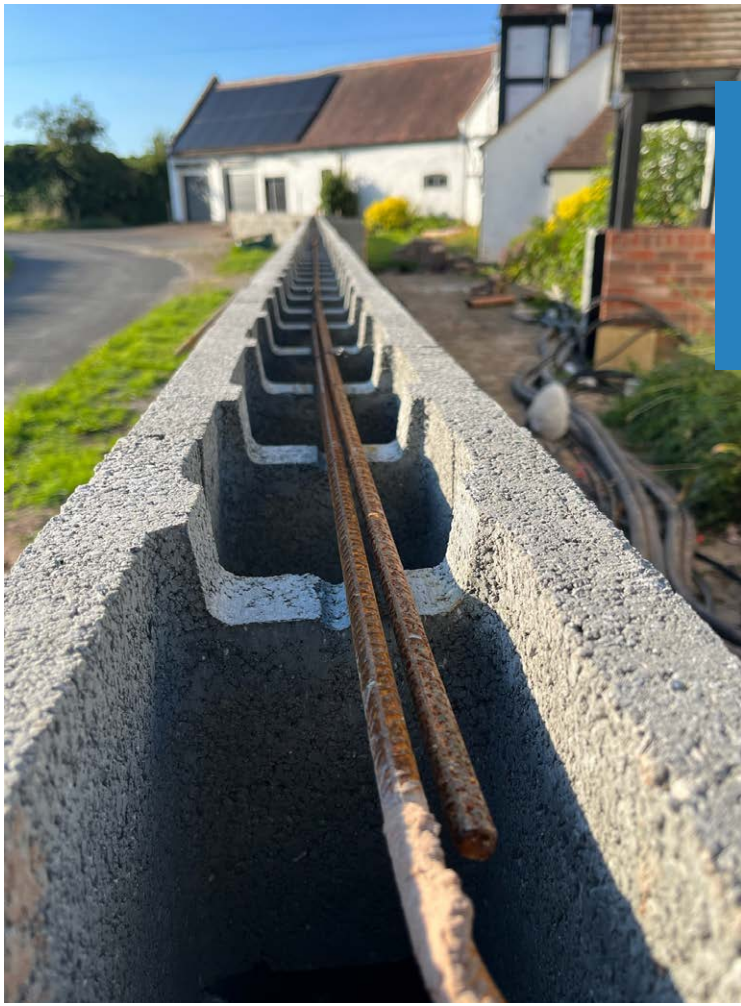
Stepoc is a precast concrete block retaining wall system that can be laid dry. The blocks are hollow, which allows for reinforcement bars to be inserted and for concrete to be pumped through the interconnected cavities in the blocks. The block's unique design creates a cascade or waterfall effect, which ensures a smooth filling of the pumped concrete. This forces the air out, eliminating segregation and creating walls that have immense compressive and lateral strength.

Read more about **Stepoc** blocks ❯



Concrete curtain below foundation to stop water flow under the wall



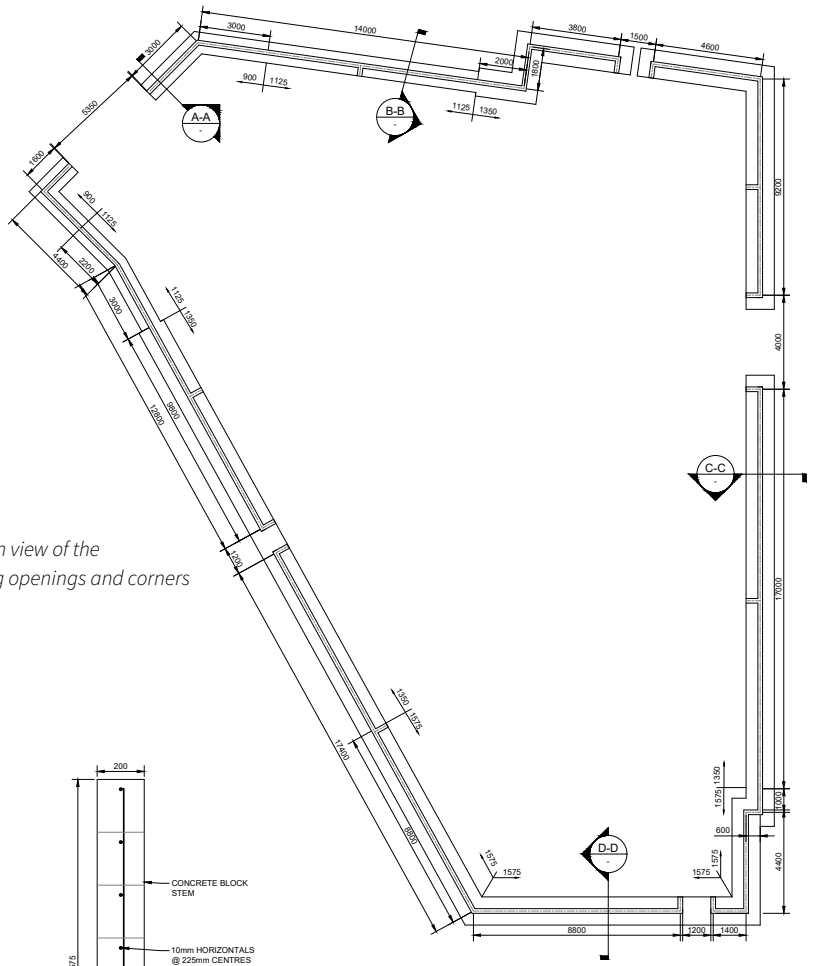


Useful link

Stepoc retaining wall is a system of concrete shuttering blocks, which are dry laid

ibstock.co.uk/products/retaining-walls/stepoc

Detailed plan view of the wall showing openings and corners



PLAN ON RETAINING WALL
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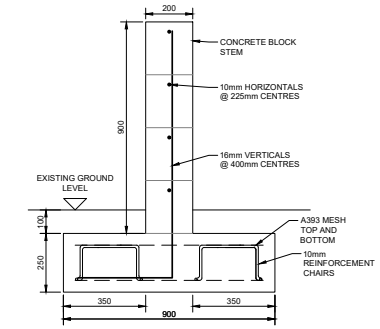

SECTION THRU 4 BLOCK TALL WALL A-A
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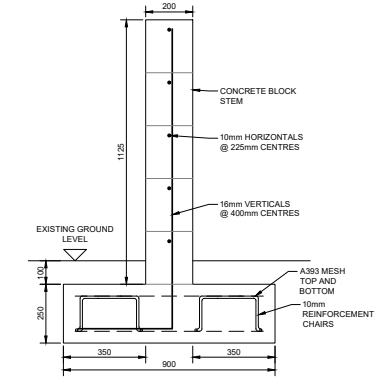
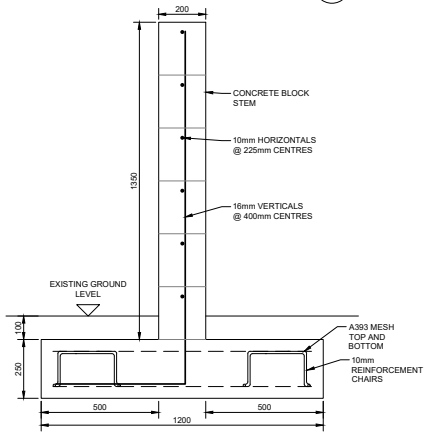
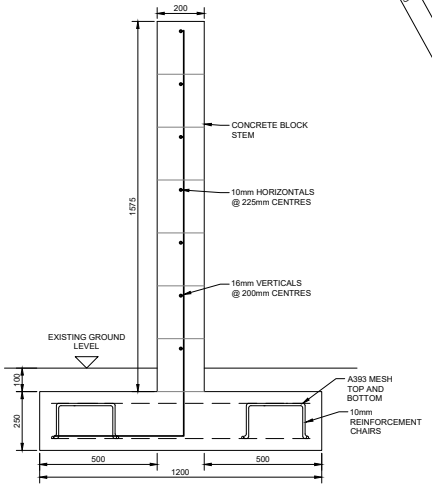


SECTION THRU 5 BLOCK TALL WALL B-B
1:10@A1



SECTION THRU 6 BLOCK TALL WALL C-C
1:10@A1



SECTION THRU 7 BLOCK TALL WALL D-D
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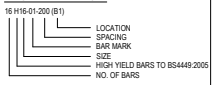
NOTES:

1. DIMENSIONS SHOULD NOT BE SCALED FROM DRAWINGS.
2. ALL DIMENSIONS ARE SHOWN IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. ALL LEVELS ARE SHOWN IN METRES
4. SCALES NOTED ON THE DRAWINGS ARE NOT APPLICABLE TO REDUCED SIZED PRINTS.
5. CONCRETE SHALL BE MIXED AND PLACED IN ACCORDANCE WITH BE EN 1992-1-1 STRUCTURAL USE OF CONCRETE.
6. ALL CONCRETE TO BE MINIMUM GRADE C32/40.
7. CONCRETE GRADES IN ACCORDANCE WITH BS EN 1992-1-1 STRUCTURAL USE OF CONCRETE.
8. CONCRETE BLINDING SHALL BE THE SAME GRADE AS STRUCTURAL CONCRETE ENCASEMENT.
9. REINFORCEMENT TO BE GRADE B500 TO BS 4449.
10. CONCRETE COVER TO BE MIN 50mm ALL AROUND.
11. MINIMUM LAP TO REINFORCEMENT TO BE 40d.
12. MINIMUM LAP TO MESH TO BE 600mm.
13. REINFORCEMENT CHAIRS TO BE INSTALLED EVERY 2m.
14. CONCRETE COVER TO BE 50mm.
15. TYPICAL BAR REFERENCE:-



P03	FB	REVIEW & COMMENT	FB	LZ	EP	17/05/23
C01	FB	FOR CONSTRUCTION	FB	EP	EP	12/05/23
P02	FB	FOR COMMENTS	FB	EP	EP	02/05/23
P01	GR	FOR APPROVAL	GR	EP	EP	19/04/23
REV	BY	STATUS	DSG	CHK	APPD	DATE

DESIGNER

CLIENT
MR NICK LUPTON

STATUS
A1 - FOR CONSTRUCTION

PROJECT
PIXHAM HOUSE

TITLE
RETAINING WALL
GENERAL ARRANGEMENT & DETAILS

DRAWN	FB	17/05/2023
CHECKED	LZ	17/05/2023
APPROVED	EP	17/05/2023

SCALE: AS STATED
SHEET: 1 OF 1

DRAWING REFERENCE
REV. P03

Fares El-Bader 17/05/2023

A 1

Demountable Flood Barrier

This is a really important part of the wall design, as inadequate planning could create a potential weak point in an otherwise strong wall. For us, the thought of a barrier failing is horrendous, as it could lead to a rapid flood inside the wall, followed by the house shortly after. We therefore thought hard about both the number and width of the openings in the wall. Bearing in mind that one of our openings was to be 4 meters wide, we needed to have confidence in the product that we chose.

Ultimately, we selected **Lakeside Flood Solutions**' Demountable Flood Barriers.

To enhance the wall's structural integrity around the openings, we decided to put buttresses in. While we were assured it wasn't totally necessary, it felt the right thing to do. There is a lot relying on the end of the wall, so buttresses made sense to provide extra rigidity where the barriers attach.

Read more about how we decided on the barriers ❯

Useful link

Lakeside Flood Solutions As a long-established and reputable company with 35 years' experience, they provide an unparalleled assurance guarantee that our flood defence products and installation services are of the utmost highest standard.

www.lakesidefloodsolutions.co.uk

Removal of groundwater

It is important to understand that the wall will not be perfectly water tight and won't entirely prevent water from appearing on the dry side. With significant water pressure on the outside, a hydraulic gradient will develop underground in the form of the water table, potentially leading to seepage under the wall and raising the groundwater levels on the dry side. If nothing is done to counter this rise of the groundwater, the dry side of the wall will gradually flood and result in flooding your home.

Read more about hydraulic gradients ›

In terms of designing a drainage and pumping system, this was much more of a gut feel for us, based on our experience with how high floodwater we would get during a flood up the walls of the house. Plus, we knew the significant volumes of water being pumped by the existing pumps from under our house.

We decided to place sumps in three locations: one at the lowest point inside the wall and two at the front and back of the house, 180 degrees apart. Each sump is connected to 100mm land drain pipes. These are flexible, perforated plastic pipes laid on top of the foundations, which are wrapped in non-woven fibre matting to keep any significant particulate (soil) out of the drain. They are then covered in gravel to aid drainage.

Each sump contains a single pump capable of handling a flow of approximately 5 litres a second (l/sec). The amount of water volume you will need to deal with will depend on the soil structure, which in our case was mixed (sand and clay). The sumps we installed are capable of taking a larger pump of around eight l/sec however the smaller ones are cheaper and have proven to be adequate. In the event of a pump failure or becoming overwhelmed, it is possible to place a portable pump or two in the chamber to ensure there is adequate discharge flow. If you have a spare pump it is easy to exchange the pumps, even during a flood, as it is raised and lowered into the sump using a chain and rail system, which engages the pump discharge with the outlet pipe.

I was not far out with my initial choice of pump size. Almost three months after the wall was completed, we experienced one of our highest floods. I estimated that we needed to remove approximately 10 l/sec of water at the peak of the flood. I intend to buy a spare pump to cater for any breakdowns in the future and will upgrade to the larger pump size.

The sumps are designed for waste water applications, moving foul water from a low level to a higher level. They can pump solids of up to 50mm, so are good in terms of removing any small stones or lumps of earth entrained in the water.

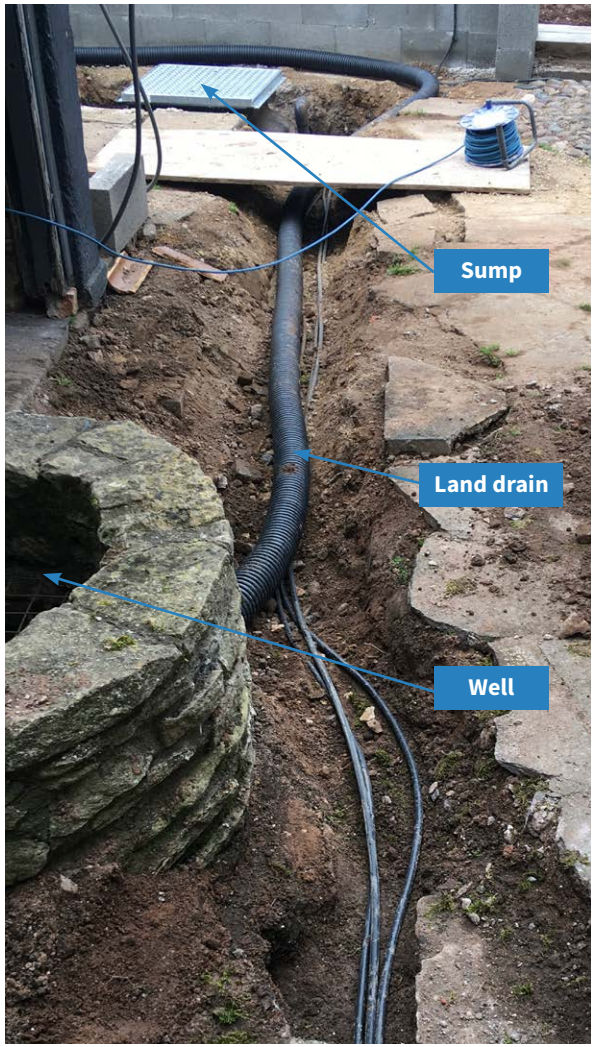
We bought our system from **Direct Pumps and Tanks Ltd.**

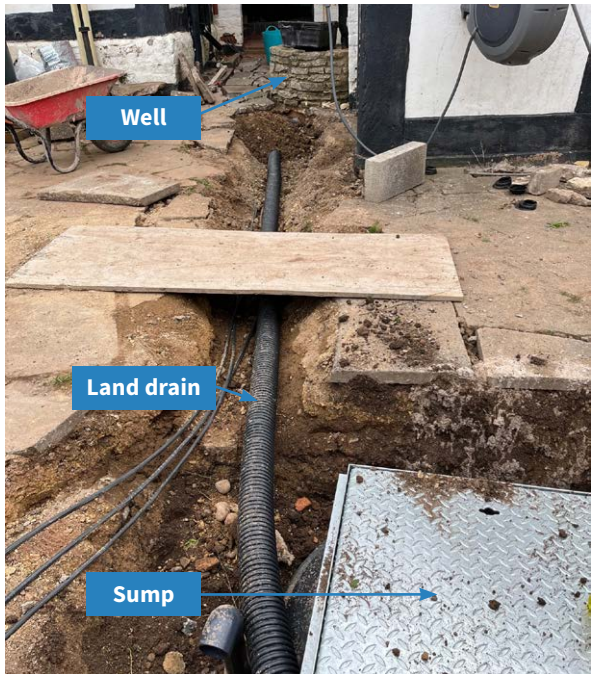
The pumps discharge out to the wet side of the wall via a non-return valve, which is all part of the sump design.

Sizing of the sumps was another consideration. I chose large 800-litre sumps to reduce the start/stop cycles on the pumps to a minimum so giving them a longer lifespan.

Regarding the electrical supply, I opted for a separate circuit for each of the sumps. Each sump pump is connected to a separate breaker from the consumer unit, with a double plug, allowing for easy replacement or the addition of backup pumps without affecting the other sumps. If a single switch was used for all three sumps, it would have the potential for a single motor fault to stop all three pumps. This eliminates this risk.

Another issue we had to deal with was a well, which is located on the 'dry' side of the wall. Instead of lowering a temporary pump into the well, we excavated a trench, drilled a hole in the side wall of the well below ground level, and installed a land drain that routes it to one of the sumps. This solution has proven to be extremely effective, allowing the installed sump to handle extra groundwater from the well. (see pictures)





Useful link

Direct Pumps & Tanks has been established and successfully trading in the pumping industry since 1996. It is one the leading suppliers of package pump stations, cold water booster sets, and rainwater harvesting systems in the country.

www.directpumpsandtanks.co.uk

Services that will go under the wall

Every site is different when it comes to services to and from the house, such as sewer systems, power supplies, and underground water lines. You will need to consider if you are connected to the mains sewer or private septic tank, whether your power supply is underground or overhead, and if your drinking water supply is buried. Additionally, there may be a network of soakaways or cables supplying electrical equipment outside the wall. Identifying the location of these services is crucial when you come to dig the foundations, as it will help you to know where to slow down and hand dig. Using spray paint, we clearly marked the points where we knew services crossed the path of the wall.

One technique that I was extremely sceptical of was dowsing. My builder said it works and set out to prove it! Using some wire coat hangers bent into a right angle, he showed me where the water main was and the sewers. For the latter, I knew the route and he was spot on. When we started digging, the water main was exactly where the dousing had identified it. After trying dowsing myself, I must confess that I'm a convert; don't knock it until you try it!

Other services are easier to deal with. Sealed systems such as drinking water and power cables can simply be routed under or through the wall.

Soakaways also need consideration. We discovered several, some of which I knew of, while others were new to me. Some were redundant and full of earth, but others were draining surface water, mostly from roof drains. I decided the surface water could soak away inside the wall and any excess water would end up being pumped out by the new sump/pump system. Having lived with this arrangement through one very wet winter, it has proven effective, with only occasional pump operation during exceptionally high rainfall and already saturated ground.

Dealing with the sewers was more challenging. As mentioned, every house and flood location is different, in terms of how quickly the flood arrives and subsides. In our case, we have several days notice but once flooded we remain so for up to a week. During this time, we are going to need to shower and go to the loo. Our property has a septic tank, which is outside of the wall so has water pressure in it relative to the height of the flood. This pressurises the sewage pipework under the wall so it will backflow into the downstairs toilets. We have Non-Return Valves (NRVs) installed, which are at least 15 years old and although they stop most of the water, they do not seal perfectly so seep water backwards. While adequate for a flash flood that comes and goes quickly, they are not reliable for prolonged flooding. I currently seal the sewer lines with a bung prior to a flood to prevent the downstairs toilets from overflowing. Alternatives such as balloons in the U-bend or pan seals are also available, as detailed in the FREE Property Flood Resilience eBook (see 'Useful links' panel).

The drainage from our upstairs bathroom is via a sealed system under the wall to the septic tank. Flushing the loo or using the shower upstairs creates enough pressure to push the water and waste down the pipe to the septic tank, as the water level is higher than the floodwater. This arrangement has worked on many occasions. In fact, when the flood subsides, it may well pull any residual waste into the tank. When we inspect after a flood there is no sign of blockage and the septic tank just returns to its normal level. We also pump it out in spring to make sure there are no excessive mud deposits left behind.

I definitely have more work to do dealing with our sewer system. While the current arrangement works, it is inconvenient and requires preparation. My long-term plan is to install newer model NRVs that can be positively locked closed at the valve, removing the need to manually access and seal the sewer line before a flood. There are many other options here and these are explored in the following link from Simon Crowther of FPS. (see 'Useful links' panel).

Useful links

The FREE Property Flood Resilience eBook

Stories from homes and businesses who have made adaptations to help them recover more quickly after a flood.

Property flood Resilient eBook

More information on NRVs from Simon Crowther of FPS

Drainage Networks and Backflow Protection

Further Considerations

Just when you think you have thought of everything there are always important things you might have missed...

Consents and permissions

This has already been covered however I urge you again to look into this as early as possible. The wall may be a high priority for you, but it will not be top of the list for the council, EA or any other organisation you engage with. Having this sorted out as soon as possible is well worth the effort.

Funds

Each of us have different financial circumstances, but what is important is once the build starts that you have the ability to pay the associated costs. For short term spending, increasing my credit card limit was extremely useful although I nearly exceeded the limit on a couple of occasions. We had some modest savings, which helped but most of the construction was covered with remortgaging. Whatever your arrangements are, make sure they are in place early so you don't have to stop the work due to lack of funds. It will always cost more than you think. If it doesn't, it will be a nice surprise, but allow a healthy contingency.

Building/construction

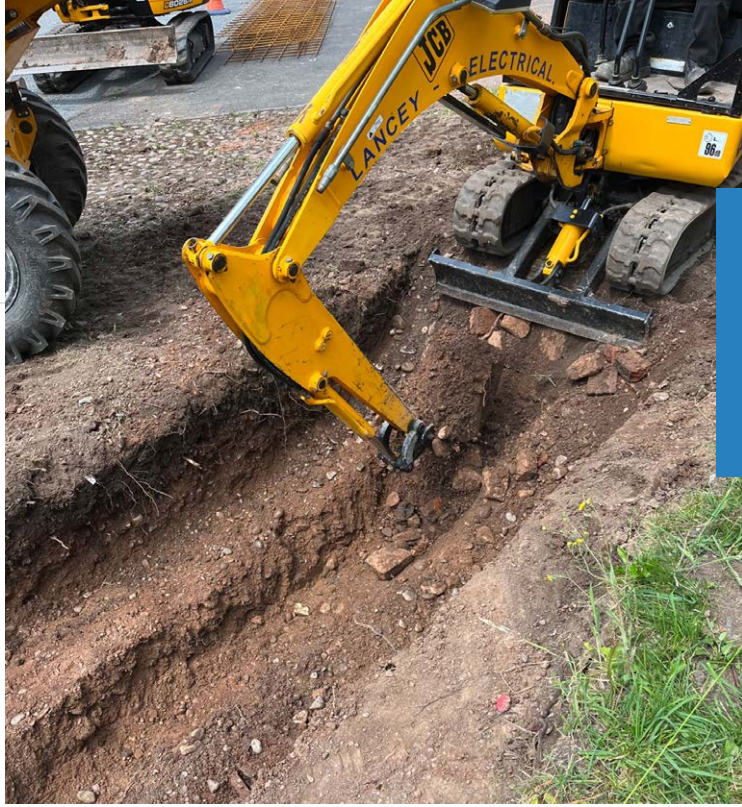
Prior to this project, I had no significant experience of building work. I was very aware that I would have made a terrible job of the foundations and construction part of the wall. The arrangement I came to with our builders (Roger and Tom), who had completed smaller jobs for us in the past, was they would do the work that was too complex for us.

If that sounds vague it was, and somewhat open ended. This turned out to be a significant amount of the work, consisting of the ground works for the foundation, driving the digger (accurately), the first course of blocks, concrete pouring, installation of the sumps and electrical supplies for the pumps.

To help the job along I laboured for them; it's hard graft but you get to see the project develop first hand. The other advantage is you are immediately available for any decisions, of which there were plenty (you will always find unanticipated objects as you progress, drains, cables etc.). This arrangement also had the added advantage that I gained a wealth of experience from construction professionals. It gives you confidence to do more yourself if future projects that arise.

In our case, we agreed on a daily rate with the builders. This suited the builders as there was no estimating required, therefore no risk for them to factor into a quote. This arrangement also worked for us, as we already had excellent relationships so worked together without issue. However, some builders may not welcome the client working alongside them – and you may not want to do the work, but project manage. Establish clear ground rules from the start for what works for your situation and maintain open communication throughout.

If time is an issue or you have full-time employment, you may opt to have a builder handle the entire project, including purchasing materials, hiring plant equipment, and overseeing construction. While this approach may be more expensive, it is likely to be less stressful and demanding.



Lay-down area

You will need a designated area to store materials close to where they will be used, but not interfering with ongoing work. For example, the concrete blocks we used consisted of over 40 pallets and required careful planning for their delivery and storage Most blocks were delivered before foundation excavation began to avoid the need to keep moving them multiple times.

Additionally, we needed an area for cutting and assembling of the steelwork mesh cages before lowering them into the foundation. The A363 mesh was 4.8 x 2.4 metres, with around 25 sheets meaning they occupied a sizeable area even when stacked. Other materials, such as sand and cement, also need to be considered as you will need these to be readily accessible. Every project will have different logistical issues so thinking ahead will help to reduce work later.

Further Considerations continued...

Spoil

Do not underestimate the amount of spoil you will create. There will be more than you expect, particularly as it seems to expand in volume when dug up and piled above the ground. You will need a convenient place to store it during the build, perhaps to be used later to backfill. If space is limited, you may need to arrange for waste removal, which can be costly. A friendly local farmer might be interested in topsoil or hardcore and offer to take it away for free. Separate different piles of hardcore from soil for future use. You could also consider whether any spoil can be used to form a bund wall as part of your flood defences. We didn't have the space, but if you do, it is potentially a win/win in terms of the bund saving the cost of a section of wall and on the disposal cost of spoil. It is worthwhile considering.

Access for plant

The order of build for our site was dependent on the access, not only for the digger and dumper but also for the concrete mixer truck to deliver concrete to the foundation. We started at the far side of the house and worked round to the front. The progress rate of the foundation dig and concrete pour was dependent on getting the concrete trucks close enough to the foundation hole. If we dug too much foundation at once, the truck couldn't deliver the concrete to the right place. Think carefully about what needs to get to where on your site.

Plant Hire

We used a local plant hire company (WHC) and developed a good relationship with them. It was a real help to have flexibility and change plant at relatively short notice when necessary. Sometimes we returned plant back earlier than agreed or downsized due to access limitations in the work area. We started with a 3-tonne digger and dumper, then reduced to a 1-tonne digger as access became tighter and finally a 1-tonne hi-lift dumper. Every site will have different needs; larger equipment moves more spoil quickly but is no good if it sinks into the grass or can't access the required area.

Plant hire is a significant project cost, so ensure the right plant is on site when needed and it works. Build a good relationship with the local hire company's team, and they are likely to be more flexible if kit is returned earlier or later than originally booked. This will help keep your project on track.

Project Management

In our build, I managed the project. This was a full-time job for the four months of the construction and about a month before the start for preparation and purchasing materials and equipment. This was the first time undertaking a project on this scale, so I learned as I went. As well as managing the overall project, I also laboured for the builders when they were on site or progressed the 'non-skilled' parts of the job when they were not around.

There was nothing too clever here, mostly it was making sure the required materials, plant or labour was available, when it was needed. Having been involved in the design, I was on hand to monitor progress. Overall it was about keeping the cost as low as it reasonably can be while moving the job on as quickly as necessary. In the link below, there are some ideas and tools I used. I am not a trained project manager and did not employ any professional tools for the job such as Gantt charts, but managed with simple charts and spreadsheets.

If you have more skills than I did, there may be sections of the work you are confident to progress. Being fully involved in the project means you have the fulfilment of participating in a significant project that improves your home and your wellbeing. You will be closely involved in the design and the construction, ensuring it meets your needs, without being over-constructed and unnecessarily costly. Being on hand for any decisions is crucial, as unexpected issues can arise, which need immediate attention to avoid delays and extra money.

Planning

I used a simple spreadsheet to display the jobs and their order. This is not typically how spreadsheets are used, but it worked for me. I listed individual tasks down the left-hand column and weeks across the top, creating bars to indicate the duration of each job and the order in which to progress each task. I updated this at least once a week, usually more frequently.

See sample of a Planning spreadsheet ›

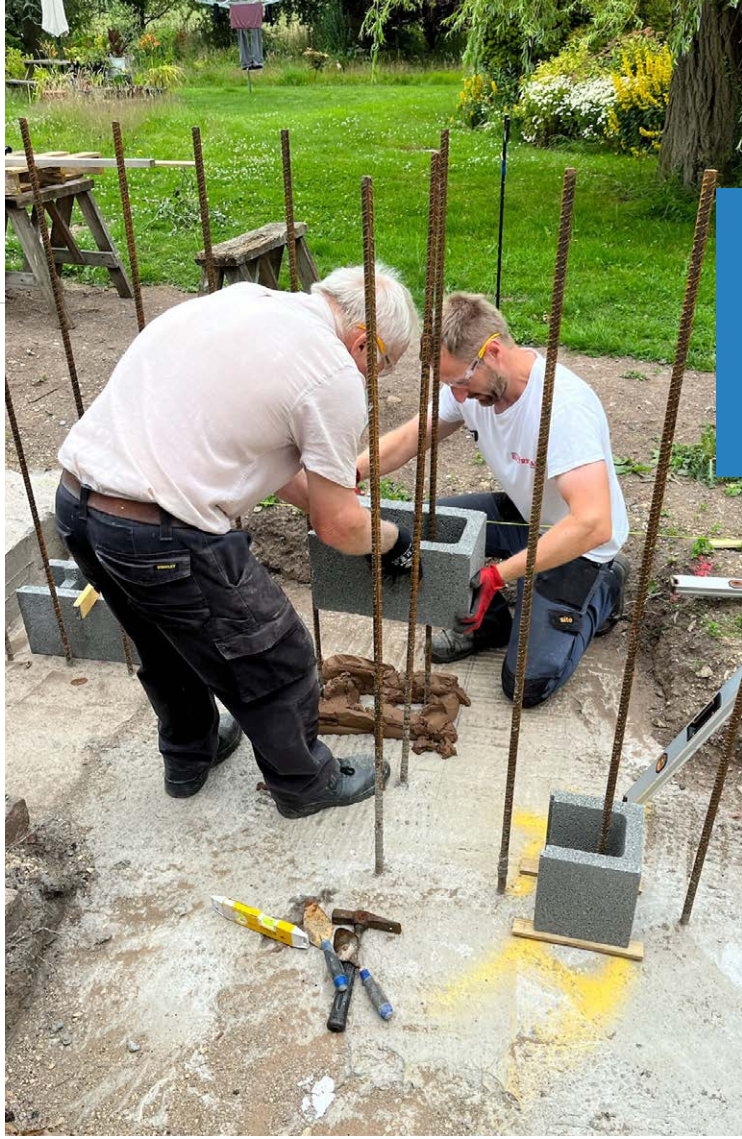
Cost Control

A useful tool for controlling costs was a 'Bill of Quantities' spreadsheet, which was supplied by Retaining Wall Solutions for a small fee. This really helped me to anticipate and control the project's budget, so I highly recommend using something similar.

See sample illustration of a Bill of Quantities ›

Builders

Whatever your arrangement is, ensure you have a solid understanding of your builder's availability over several months, as skilled labour is an expensive part of the project. Fortunately in our case, our builders were flexible with their hours if given reasonable notice, and I was flexible if they had urgent jobs to attend to. Avoid having plant on site that is not being used, or builders on site with no materials or plant to work with. Being on site myself and labouring for the builders was a great advantage, as discussions and decisions could be made then and there, with minimum delays. Many issues were promptly resolved just by being available.



Useful link

The 'Bill of Quantities' spreadsheet we used was supplied by 'Retaining Wall Solutions' and it really helped me anticipate and control the budget for the project.

retainingwallsolutions.co.uk

Buying materials / Procurement

This is where the project really starts to hit the wallet! Full commitment is needed from here. As previously suggested, increasing your credit card allowance will help to ensure you have good cash flow for ordering materials.

You will need a builders' merchant. There are many companies around, so it is worth researching what's available in your area to get the best combination of price and convenience. We used Travis Perkins, who are surprisingly competitive if you buy in large quantities. Don't be put off by the prices on their website. Get to know the store manager and discuss your requirements. There is a balance between best price, the convenience of one supplier, and getting what you need delivered. If the price is too high, it is worth shopping around, but we found that buying in large amounts often resulted in competitive pricing, and the convenience made it worth a little extra cost. Delivery to your site is also a factor; you don't want to be running around with bags of cement in your car boot! It's much better to have a pallet delivered along with bulk bags of sand etc.

Be clear on material lead times; booking early puts less pressure on the project, and the materials are on hand to start work. It does mean finding space for lay-down of the materials in a place that is both convenient for the job and not in the way. If space is an issue, you may be able to delay deliveries until they are needed. For example, our **Stepoc** blocks came on three lorry loads and arrived before we started the wall. In hindsight, it would have been more convenient to deliver the blocks in two batches, timed for when they were required. If you do this, just make sure you have the right mix of blocks, including end blocks and standard blocks, in the first delivery.

Blocks

The **Stepoc** blocks were a large part of the wall cost. We had approximately 1,600 blocks on 40 pallets. The delivery cost was over £1,000 as they came in separate deliveries from Merseyside. We had to order them through a builders' merchant as the factory would not take direct orders. We used Travis Perkins after getting a quote directly from Ibstock. Since then, there is now a local builders' merchant that stocks **Stepoc**, which might have saved some delivery charges, but too late for us. The pallets were moved from the truck to the lay-down area with a forklift, but be aware the pallets are very heavy, and the forklift will cut up your lawn if it is at all soft.

Steel

The Schedule of Steel was a huge help with ordering the steel mesh and rebar. Travis Perkins was very happy to take the Schedule of Steel sheet and quote based on that. The rebar, mesh, and bars arrived in one load, so be prepared with the lay-down area and access for the truck. We had around 1.5 - 2 tonnes of steel to deal with so putting it close to where it is needed will save effort later.

Don't forget rebar ties and tools for tying the rebar. We ordered 1,000 ties initially but ended up using 3,000 and ordered an extra tool to speed up the process. Don't forget your PPE, particularly for cutting the rebar mesh.

Concrete

Concrete was a mystery area for me initially; there was a lot to learn. I knew very little about specification, delivery, and laying of concrete. The good old internet came to the rescue, with plenty out there to help you learn the ins and outs. Discussions with the suppliers also helped me to understand how to acquire what was needed. We used over 50m3, so this is a big part of the project and one of the major expenses. On reflection, I could have negotiated harder with the supplier for better price, given the size of the order. When you know the foundation design and wall square meterage, you can do a concrete volume calculation to get an approximate idea of the volume required.

Read for lots more information on concrete ›

04 How did we actually build it?

Finally starting the physical work...

Building the wall

The wall construction began in earnest when the builders arrived on site in mid-May to avoid the flood season. Although there were no guarantees, the chances of flooding were less likely in the summer.

As you can see, there was a lot to consider prior to getting to this stage and I should've done more preparation, but the clock was ticking and I'm a bit impatient! Before the builders arrived, we cleared the site, rescued plants in the line of fire, and received the major material deliveries,including the **Stepoc** blocks and steelwork. The digger and dumper were also delivered to site. Detailed preparation optimises the time spent when you are paying someone to do part of the work; the better the preparations, the more you will save.

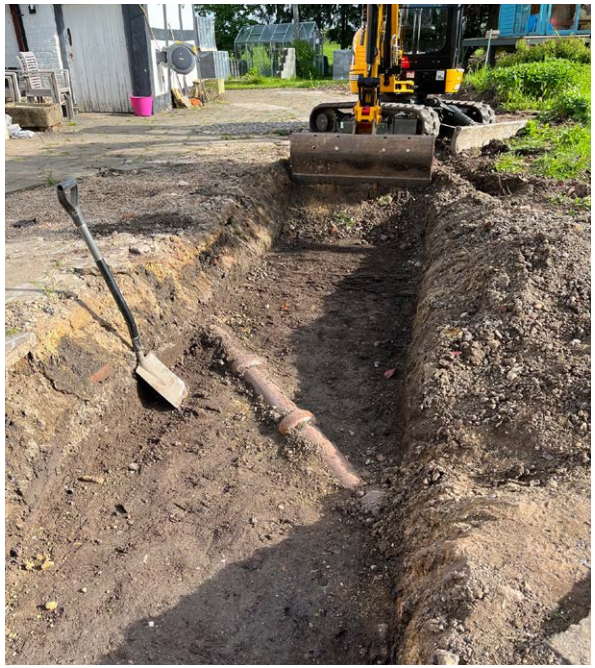
Digging the foundations

We had marked out the route of the wall, location of openings, corners, and minimum heights. The builders did a more detailed survey, setting reference heights all the way round the house, essentially checking the work I had done previously. This was achieved using a laser level to identify the points where the foundations would change height. Fortunately, this survey corresponded closely with my earlier calculations. The builders erected posts and ran lines to mark the route of the wall and the edge of the foundations. The plan was to dig the wide foundation first and the deeper trench second.

It became apparent that the digger bucket size was important here. The wide foundation needed a wide grading bucket to remove the soil in one sweep and scrape the level until it was at the correct depth. Matching the foundation design with the grading bucket makes it a quicker job. We had to hire a slightly larger bucket as we hadn't anticipated this need.

As the soil was scraped away, the depth was checked with a calibrated stick and a laser receiver set at the required level to ensure the bottom of the foundation was the correct depth. This meticulous process was repeated for the entire length of the foundation.

The design incorporated a deeper narrow trench in the middle of the foundation to reduce the water flowing/ seeping under the wall. While this non-structural part of the foundation cost significant time and effort, it was worth it to improve wall's stability. Having experienced a few floods, I wouldn't want more water on the dry side of the wall and who knows what it would have been like without the deeper trench.



Initial foundation dig

Centre trench excavated

Steelwork

Before starting, rebar work was a completely new area for me. It took some internet research to understand the requirements and how to tie rebar together. The design drawings made it clear what was required and where everything should go. It is important to have the rebar correctly located to provide proper support to the steel reinforcement system. This should be clear in the design if you have used a designer or Structural Engineer.

Read for information on Reinforced Bar ›

For example, for the L-shaped vertical rebar's foot is angled to the dry side of the wall and rests on the top of the bottom mesh sheet of the cage. This way, the water force on the wall and the bar spreads across the mesh in the foundation, greatly enhancing the wall's strength. The horizontal rebar is resting on the vertical bars as well so creating an extremely strong wall structure once the concrete is poured. See photos right.

Once the cages were built, they were laid in the hole on 'Mars Bars' - the trade term for square concrete/fibre bars – to ensure the steelwork wasn't in contact with the ground, but completely covered with concrete to prevent rebar corrosion.

The vertical L-shaped rebar was then tied into the mesh cages in the correct position. This required careful measurement to ensure the vertical bars coincided with the holes in the blocks. The spacing of the vertical bar was 400mm for most of the wall, but for the seven courses section, we had 200mm spacing for extra strength. The

Mars Bars to rest the cages on in the foundation

corners were tricky to measure and tie in, but the run of vertical bars are aligned.

Prior to pouring concrete, we used timbers with holes drilled to ensure the bars remained correctly spaced and vertical during the pour. This bracing was crucial, as the concrete flow could otherwise push the bars out of alignment.

Rebar construction may seem daunting at first, but was quite satisfying once started. For cutting the bar, a 9" angle grinder and the correct PPE are highly recommended. There is a lot of cutting to do!

The building of the rebar cages was something Annie and I could do, while the builders were progressing the detail of the foundation. We also tied most of the vertical rebar once the builders confirmed the dimensions.

More details on building the Rebar cages and laying them are explained on the following pages...

Top tip. The A393 mesh is 200mm squares. If the mesh cage is lined up in the foundation carefully the tying of the vertical rebar would coincide where there is a cross in the mesh making the tying of the bars much easier.

Tying the rebar with the Draper twister tool

Rebar Construction

After excavating the foundations, the first rebar to be installed was the mesh cage. These were mostly constructed on trestles next to the foundation hole and then lowered into position. They do not sit directly on the earth but on the Mars Bar blocks to ensure the concrete completely covers the rebar, preventing steel corrosion over time.

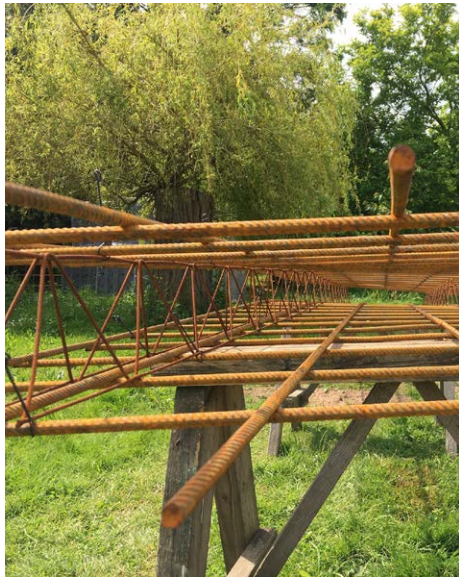
The A393 mesh needed to be cut long ways to create a bottom and top sheet. These are separated by 'chairs' to maintain separation between the mesh sheets, and to make a fairly rigid structure.

There is a lot of steel cutting to do. We tried bolt croppers and found cutting 10mm steel was possible but took quite an effort. The best cutting method was a 9" angle grinder with a diamond disc. Although the diamond disc is not cheap, one disc lasted the entire job. A smaller angle grinder was used for some cutting but took much longer, making the investment in a 9" grinder worthwhile.

The chairs and ties are non-structural, and are only there to ensure the correct separation or alignment of the rebar before pouring concrete.

The art of tying rebar was another internet research job. The ties come in boxes of 1,000; we used nearly 3,000 ties, perhaps a bit indulgent but it gives an idea of the quantities needed.

A twisty tie tool (Draper) helped enormously, and we ended up with two tools to speed up construction.



Cut the 'chairs' and mesh to size then tie the chairs to the bottom mesh sheet. . Then tie the top sheet to the top of the chairs forming a cage like structure.

Laying the Rebar cages

There is quite a bit of complexity to laying the cages in the foundations due to the corners and level changes. There was also a requirement for mesh overlap to maintain the strength at the joins between cages. The design drawing specified a 600mm overlap. We achieved this mostly by adding a sandwich of mesh, but occasionally staggered the sheets to ensure overlap, although this approach often meant building the cage in the hole, which was awkward.

When placing the cages in the foundation, aligning them for the placement of vertical rebar was important. The mesh, consisting of 200mm squares, was extremely convenient for placing and tying the vertical rebar at 200mm or 400mm spacing.

The vertical Lshaped rebar could be tied to the mesh cage in the correct position using the mesh as a guide. Of course, this required careful measurement to ensure alignment of the bars with the holes in the blocks.

In comparison to the vertical rebar, the placing and tying of the horizontal rebar was quite straightforward. As each course was completed, (pre-cut to the right length), it was placed in the groove in the block and tied to the vertical rebar, with a horizontal bar installed in every course.

We used timbers with holes drilled, to ensure the bars remained correctly spaced and vertical during the pour

The pre-cut lengths of bars were placed in the groove in the block and tied to the vertical rebar

Top course horizontal rebar laid in groove

Stability of the foundation walls

There was a concern about the risk of the foundations collapsing, especially due to rain, before pouring the concrete. A collapse could mean having to repeat the excavation, potentially by hand, and removing any assembled steelwork to re-dig the hole. Clearly it was something to avoid, and therefore summer was favourable to reduce the risk of rain.

Clay-like soil tends to be more stable for foundations, but we encountered some sections of sandy soil, which are far more prone to collapse. To mitigate this risk, our goal was to dig the foundation, fix the rebar in place, and pour concrete as soon as possible. Once the concrete was in, the foundation was secure. We always checked the weather report and covered the holes with tarpaulins if rain was likely.

A few times, rain caught us off guard after the rebar was installed. We had to hastily cover the foundation and channel the rain away from the hole. On one occasion,rain did get in despite covering the foundation, requiring us to remove soil from slightly collapsed sides. Fortunately, we didn't need to remove the rebar to re-excavate, but it might have been necessary if more rain had got in.

If you are working in winter or have extensive sandy soil, consider shuttering the foundation sides to keep them stable once excavated. This reduces the risk of rain collapsing the sides, though it does involve more work and materials, but could save delays.

Pouring the concrete

Pouring concrete was a bit of a mystery area, so I had to do a lot of research in advance.

For our wall, access for the mixer trucks was an issue, making it difficult to offload into the foundation hole. Some loads were ordered on mini-mixers to enable access down the back and sides of the house. To some extent, you are relying on the skill or amenability of the driver to get into the tight spots so be sure to discuss access when ordering what you need.

Timing is crucial: it's really important to be ready for when the mixer truck arrives. Have everything ready and a well-thought-out plan with contingencies. Ensure clear communications with the driver, ideally having one person to give instructions to avoid confusion. If the instruction to stop pouring doesn't get through, it can result in too much concrete being poured in the wrong place – and very quickly! Once the concrete is in the ground, it sets in a matter of hours, so best to get it right the first time.

Assuming most of the concrete is in the right place and level, it can be worked on to achieve the right finish before it sets. Concrete can usually be stood on after an hour, which feels strange given how recently it was poured. Full strength is achieved after a week or so.

To indicate the top of the concrete and ensure the correct foundation thickness, we used wooden stakes hammered into the foundation. Painting the top of these made each stake stand out during the pour.

Read for lots more information on concrete ›

Top tip. Paint the top of each stake with a bright coloured paint to make it stand out amidst the mess during the pour. Also, paint a mark on the edges of the foundations in line with where the stakes are.

Building the wall continued...

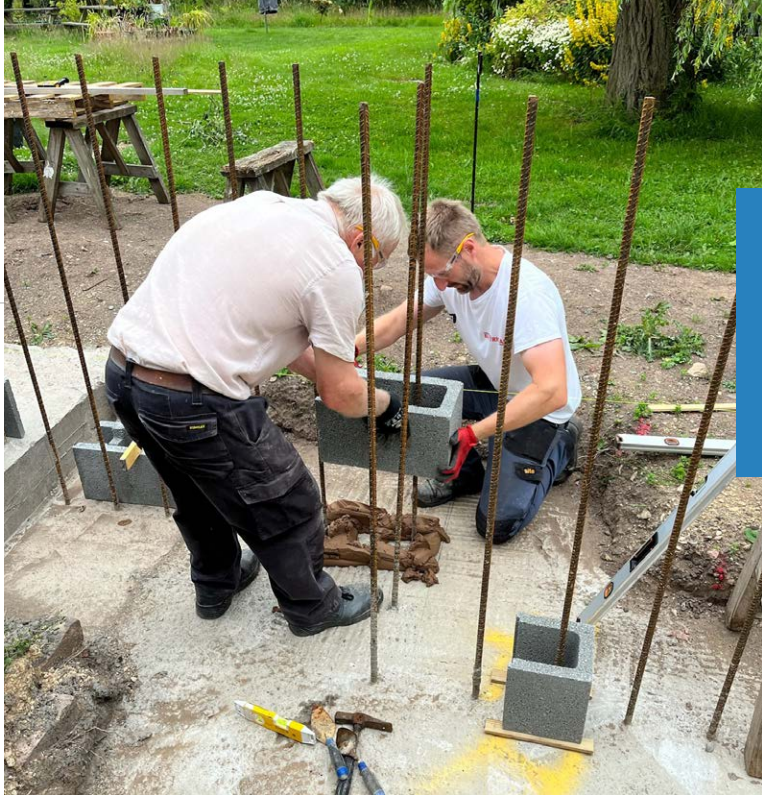
Block work

One reason for choosing the **Stepoc** block was that once the first course is laid, the rest of the blocks are dry laid. It is important to get the first course as level as possible, so this was a job for the builders. This also tested the vertical rebar layout to ensure it coincided with the holes in the blocks.

Most of the dry laying of the wall was done by Annie and I, with some help from friends. It was certainly a good workout, as the blocks are around 15kg each, but we saved significantly on labour costs compared to having a bricklayer.

As each of course was laid, the horizontal rebar was placed and tied into the vertical rebar. At this stage, it became very clear that the wall was going to be exceptionally strong, with a lattice of 16mm vertical rebar and 10mm rebar every course. Once the final concrete was poured, the wall felt like it could withstand anything and will outlast the house!

The strength of **Stepoc** is not from the block itself but from the reinforced concrete inside the block. The internal shape of the blocks allows concrete to flow not only down the gaps but horizontally as well, covering all the rebar and tying the blocks together securely.



First course mortared in

Second and third courses dry laid

Building the wall continued...

Where the wall joined the garage block it was cut into the existing brickwork to ensure stability and a strong watertight seal.

Building the wall continued...

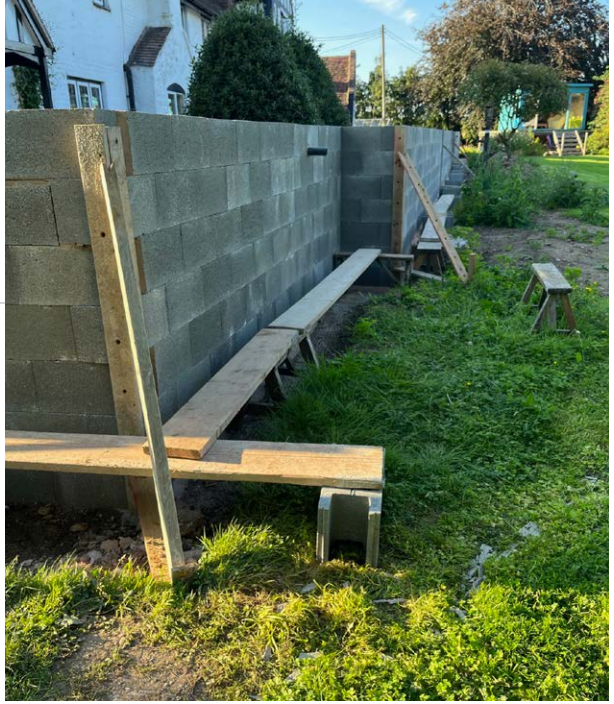
The final concrete pour to form the wall

Getting concrete into the hollow centre of the **Stepoc** blocks around the wall was always going to be difficult. The access to the back of the house had been cut off by the wall, making the far side no longer easily accessible. It was clear we would need a concrete pump to reach the far side of the wall and get the delivery pipe above the wall to fill the **Stepoc** blocks.

This required further internet research looking at the options for concrete pumping. The cheaper pumps are trucks with a hopper feeding a pump connected to pipes running on the ground, which must be manually directed to where you want the concrete to go. Lifting a pipe full of concrete overhead would have been too physically demanding, and the pipes would need to be relocated regularly, requiring flushing and moving.

It quickly became clear that we would need a concrete pump with a boom - and a big one at that! The distance from the road to the back of the house is 40m with the height of the house around 10m. A boom concrete pump that can do this is expensive, but it allows the final pour into the wall cavity to be complete in one day. The **Stepoc** specification is very clear on how much concrete is required per square meter of the wall, which for us was two large mixer truck loads.

For this work, the builders returned, and we had a couple of friends who were curious to experience this part of the project, whose extra help was invaluable. It was very useful to have the pump driver/operator visit the site a few weeks prior to the pour to give us, and him, reassurance that the boom reach all parts of the wall and avoid hazards, in our case the telephone line and our mains power supply.



The driver had experience of pouring into shuttering block walls and said they had seen some wall collapses under the weight and flow of the concrete. To prevent this, we spent two days shoring up vulnerable sections of wall: the openings, ends, and corners. On reflection, we may have over-prepared, But we had no issues and avoided having to call back the concrete pump, so I feel it was worth it. We also set-up movable platforms for the person holding the end of the concrete pipe to stand on when necessary, to position them slightly above the wall.

This part of the job went incredibly well, and we got the whole wall concreted in a day.

It was an amazing day; the wall was finally done and it was solid, however we still had four openings that needed flood barriers.

Read for lots more information on concrete ›

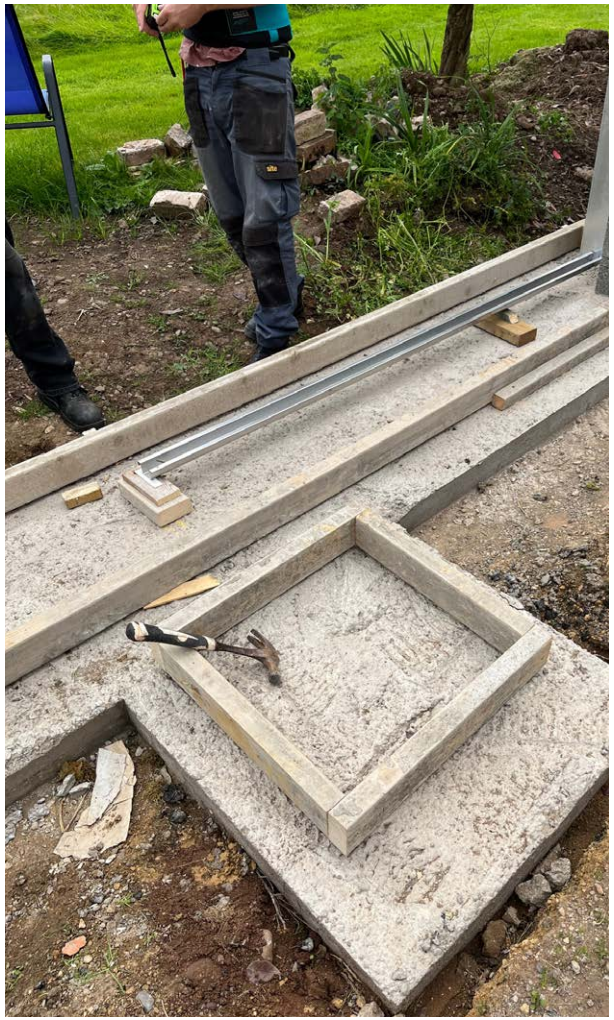
Building the wall continued...

Barrier installation

The barriers were supplied and fitted by Lakeside Flood Solutions, whose service was very good overall. Their technicians visited the site for a pre-check and to deliver the channels and brackets, which we agreed to fit. They also provided tips on how to ensure this was completed accurately and ready for their installation. They fitted the four barriers in just over a day and promptly addressed a minor issue that required a revisit, which they dealt with without question.

We had agreed with Lakeside we would mount the bottom horizontal channel, in which the bottom dam board locates, and the two aluminium L-shaped brackets that locate the side channels. The lower part of these brackets would be embedded in the sand/cement mix that made-up the sill of the opening. It was crucial to get the dimensions spot on, as incorrect placement would mean having to grind out and refit the items. After several calls to the factory to verify, the fitting team confirmed we got everything right. In hindsight I might have left the whole job to Lakeside's fitters. We did it right, but it is easy to go wrong and as I mentioned a supplied and fitted system is preferable due to its importance in the structure of the wall.

Another consideration was that the wall's foundations were not interrupted under the openings, making it a stronger structure as well as providing a continuous watertight underground curtain along the wall. As the foundation was quite a bit lower, relative to the wall and relative to the ground level where the bottom of the lowest barrier would be located, we added more concrete to reach the correct depth for installing the barrier channels.



The lower part of these brackets would be embedded in the sand/cement mix that made-up the sill of the opening.

Building the wall continued...

Having tested the barriers, I am so pleased we have the reassurance of a very strong system. They really provide confidence that we will stay dry even when there is deep water on the other side.

Installing the drains and sumps

With the wall and barriers in place, the final part was to install the means of removing any groundwater back over the wall to the wet side. This is absolutely vital during a flood, but also for removing excess rainwater from roofs and ground inside the wall when the ground is saturated.

As mentioned in the design section, we had ordered three 800-litre sumps with integral pipework and pumps. These sumps were around a metre deep with a metre diameter, requiring quite a significant hole to lower them into place.

The installation instructions for the sump specified a concrete plinth and sides to hold the sump in place. This is important as if the sump were empty and surrounded by water-saturated ground, it would become buoyant and pop-out of the ground. Fixing it in place with concrete ensures stability.

Digging a precise hole for the sump with the excavator was tricky, resulting in a larger excavation than was needed. To solve this, we had a redundant supply of crazy paving available so we built a kind of well for the sump to sit in and then poured concrete in the gap between the two. This worked for us meaning we didn't use loads of concrete for installing the sumps, though other solutions might also work.

We bought 100 meters of 100mm perforated plastic pipe land drain for the drainage pipework, which was almost enough to cover the entire wall length. It was laid on top of the inner wall foundation, wrapped in a non-woven fabric to stop fine particulates from getting in and blocking the drain, and then buried under gravel. For this we ordered 11 tonnes (a tipper truck load) of cheap, low-grade washed gravel to cover the land drains.

The sump discharge is plastic welded socket pipes. I had cut a hole in the upper course of the **Stepoc** to allow the pipe discharge to go through. These pipes are now encased in concrete, watertight, and fixed in place. A non-return

The paving slab 'well'

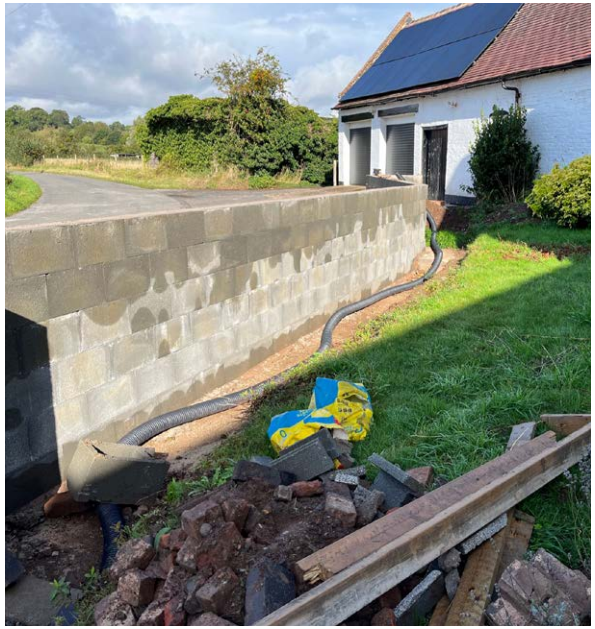
Sump in place ready for concrete

The sump has a rail system for easy replacement of a failed pump

valve in the pump discharge prevents backflow if the water outside the wall reaches the discharge pipe level.

For the electrical supply I decided on separate circuits for each of the sumps. Each sump has a double plug socket supplied from a single breaker in the consumer unit. If we had used a single switch for all three sumps, it would have been possible for a single motor fault to have stopped all three pumps, which would have resulted in wet feet!

Having a double socket at each sump is also useful for adding a backup pump if needed. Also note that the rating of the double socket is IP65, so it is weather proof.



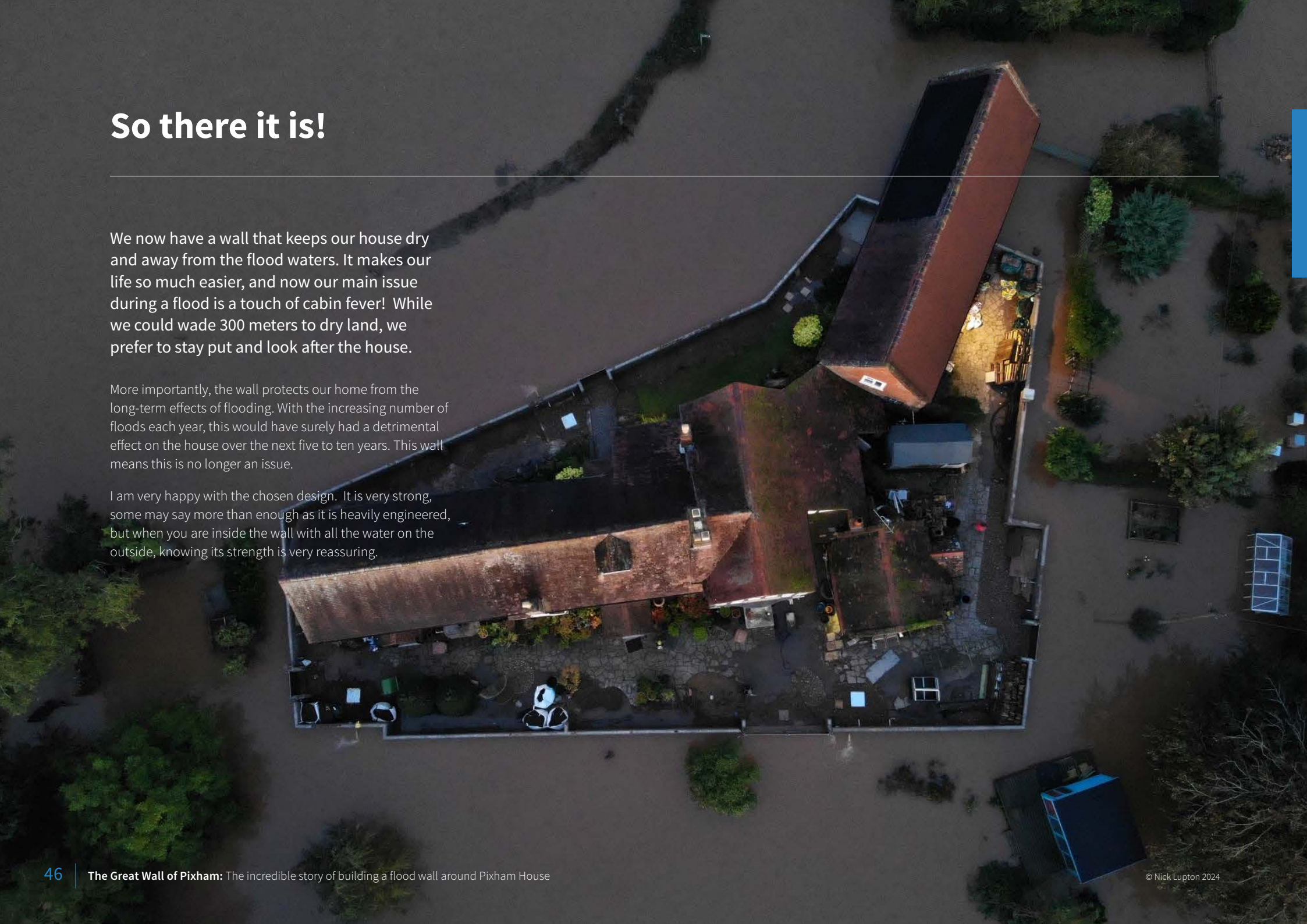
05 Has the wall worked?

So there it is!

We now have a wall that keeps our house dry and away from the flood waters. It makes our life so much easier, and now our main issue during a flood is a touch of cabin fever! While we could wade 300 meters to dry land, we prefer to stay put and look after the house.

More importantly, the wall protects our home from the long-term effects of flooding. With the increasing number of floods each year, this would have surely had a detrimental effect on the house over the next five to ten years. This wall means this is no longer an issue.

I am very happy with the chosen design. It is very strong, some may say more than enough as it is heavily engineered, but when you are inside the wall with all the water on the outside, knowing its strength is very reassuring.



What lessons have we learnt?

There are always lessons to learn. Here are a few considerations:

- **Extend land drains:** We didn't run the land drains right to the end of the back wall, which is evident by the amount of groundwater on the patio. This has now been rectified by extending the land drain further.
- **Sewer bypass solution:** I was aware of the issue with sewers bypassing the wall and dealt with this with a temporary fix. Three lines run under the wall, but one has two manholes on either side that needs a better solution. Currently a pot noodle pot and some silicon does the trick, but it is not an elegant solution! This has now been addressed with a modern non-return valve with a positive closing mechanism.
- **Increased budget**: I wished I had 20% more budget (don't we all). The foundations took longer than expected, costing more in time and money. This has led to the front wall not having a brick front - a job that is following this year.
- **Wall seepage:** The wall seeped more than I expected. It's not a problem as the sumps deal with this easily, however I would consider treating the outside of the wall with some form of tanking or waterproofing paint.
- **Concrete mixer drivers:** I should have been less tolerant of the concrete mixer driver's performance. Some were excellent but others had no care and just wanted to dump the load and leave.

Has the wall worked?

We had our first test a month after the wall was finished, following the first flood of the 2023/2024 winter. It performed well, although there were some learning points for our new setup.

Initially, I wasn't expecting the previously installed pumps below the house to pump much water, but they did – though not as much as before the wall was built. I hadn't routed the discharge pipes over the wall, but immediately found that this was necessary. We implemented a hasty solution with supplementary pipes for the first flood. By the second flood, a few months after, we had it sussed and the pumps were discharging over the wall efficiently.

This second flood was also an even greater test as it was one of the highest we have ever experienced. Again, the system performed well. The sumps and barriers coped well. We still have around 30cm to the top of the wall so there is some allowance for a bigger flood in the future.

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