

Compost System Rebuild at Abundant Earth

Design by Wilf Richards

Aug 2020 – Nov 2021

Introduction

Aug 2020

Our veg garden compost system was designed and built in 2014 by me. I did go through a design process to build it back then but the process was poorly documented apart from a few photos and a sketch of the OBREDIM process that I used. That sketch can be seen [here](#).

It's not that old but it is made from wood that is of course rotting, in fact some sections have fallen to bits and parts already replaced with scrap timber. It is time for a major review of the system with a rebuild in mind. I will use SADIM for the process this time around.

Survey

Aug-Dec 2020

In this section I am going to simply list all of my observations of the existing system. I have managed the compost system for its whole life so have had plenty of observations over the years.

System Observations

- The compost system is part of a bigger soil fertility system which in turn is part of an even bigger market garden system which in turn is part of our whole business Abundant Earth systems. It is an important cog in the system that supports the growing of our veg and turns all sorts of waste into a useful product. It certainly supports us **obtaining a yield** on many levels.
- There are five bays in a row located centrally in our market garden, in between an internal hedge and our biggest poly tunnel. It was always an awkward growing space and lent itself well to becoming the compost area and supporting the principle of **relative location**.
- The five bays vary in size deliberately in order from the largest being the initial filler to the smallest being the end product bay. This saved material in its construction, keeps each heap high and is a reflection on the rotting process which shrinks the material, a detail from my previous compost systems which I **observed and interacted** with.
- The timber used to build the bays is decomposing. The upright posts are fine. They were reclaimed from our oldest fence line near our entrance which we removed as it was replaced with a laid hedge. The boards in between the posts though are falling to bits. They were a mix of old boards from previous projects and were already old, some were newer but still second hand. No money was spent on its construction. I even used old nails. It was a good example of **produce no waste** on many levels.
- The material is aimed to turn every three weeks which through my research on site has been shown to be about right to enable decomposition and is best for disturbing any rats that may have been nesting. There have been times when I have needed to kill a brood of baby rats after the mum has fled. Turning also means I can examine the product with every turn to see its progression.
- Sometimes it is longer than three weeks between each turn, which might be because the end bay has not been emptied and utilised in the garden, so this is a **limiting factor**. At other times the delay might be due to having other priorities. I keep a note of the turning dates in Trello, a project management app. Typically then the compost is ready at a minimum of 12 weeks and ideally no more than 16 weeks.

- There will be a slowing down of turning in the winter months so about 10-15 turns over the whole year. The end bay can hold a bit less than half a cubic metre, so we are producing about 4-6 cubic metres of compost each year. I am certain this could be increased. I have not though consistently kept a record of the turns so this figure is an estimate.
- The end product is pretty good being friable, dark brown and earthy.
- There are noticeable patterns in the ecological stages in each bay. The first two bays tend to get hot and primarily involve microbes. Bays three and four are more likely to contain worms, woodlice, centipedes and other bugs. The worms have largely gone by bay five, an indication according to biodynamic farmers that it is ready to use. This means that both hot and cold composting processes are included, which I think results in a better product.
- Every time I turn the material I find plastic items which I extract, some of which I can't explain their origin but assume are waste from volunteers lunch items.
- I keep each bay covered in plastic sheet and weighed down with tyres except the first filler bay. This keeps the material moist, prevents run off and the weight encourages compression and material interactions.
- There is excellent growth of nettles and comfrey around the bays which I cut and put into the filler bay. They are ***catching and storing*** the run off.
- We have earlier this year started to receive very local horse muck on a regular basis, which really needs a separate system of storage and turning, but as that does not exist we have been adding layers of muck into our first compost bay.
- There is a wide range of materials added into the system, which I can list in an Input-Output analysis.
- Material added in can often be too large and long, which makes turning into the second bay difficult.
- There are a limited number of volunteers willing to be involved in turning the compost as it is hard work.



Shows five bays, bay on far right is the filling bay, middle bay is empty because this is halfway through the turning process, Aug 2020

Analysis

Oct-Dec 2021

Input-Output Analysis

This simply shows all the types of materials that go into the making of our compost and the various yields. This tool would normally also include a section exploring intrinsic characteristics but I think that has been covered by the survey stage already.

Inputs

- Plant material from clearing beds
- Hen muck
- Hen feed sacks
- Vegetable matter from kitchen
- Horse muck
- Egg boxes
- Paper and card
- Wee and sawdust from pissoir
- Humanure from compost toilet
- Work to turn it

Outputs

- Compost
- Worms
- Leachate / Run off
- Nettles boosted by run off
- Heat

PMI Tool

Let's next explore what has worked well and not so well

Plus

- Good end product
- The process is pleasing
- Decreasing size of bays
- The scale is about right
- Good central location
- Turning to remove plastic
- Turning to disturb rats
- Simple plastic and tyre covers

Minus

- The material rots the timber
- Finding plastic in the material

- Hard work to turn it
- Unchopped material
- Never enough produced
- Limited size of end bay

Interesting

- What do co-workers think about the compost system?
- What resources are there available to rebuild these bays?

Key decision to make

I think first I need to decide if I am sticking with the same system and doing a simple rebuild, or are there radical changes required. Once that is decided then I need to explore materials available for a rebuild, look at design options and make a decision. I will also consider if the principles and ethics have an influence in the decision.

What resources are available?

- Big plywood flatscreen pallets from Adam, no cost, limited number, contains glue
- Larch planks from Abundant Earth that Matt can provide, high quality, minimal cost, mainly Matt's time
- Local timber store planks, higher cost, lower quality than our larch, will be softwood
- Paving slabs from Jules, no cost, limited number, could be used at edges and bases

What design tweaks could I consider?

- Having a large last end bay for storage of material would be great, would **remove limiting factor** in turning every week
- Using paving slabs to create a solid base, would minimise loss of nutrients into the ground but also stop interactions with the soil underneath
- Having removable panels in between each bay to enable easier turning. Beth is really keen on this.
- Having extra bays for storage of horse muck



Horse muck storage next to first bay seems a bit unorganised, Aug 2020

Ethics and Principles

Here I will explore how various principles and ethics may influence my decisions.

Catch and Store Energy - the whole compost system is about catching and storing the fertility energy of waste materials, turning it into a more useable product. The main downsides of centralising the system, as compared to just chucking materials undecomposed into random beds, is the work involved (collecting, chopping, turning, distributing) and the leaching of fertility into the area immediately around the bays. This also reminds me of the principle ***Work is Pollution***. The work of centralising causes the pollution and wasted energy of run off. This also contradicts the principle of ***produce no waste***. I am wondering how to prevent excess run off.

- A roof over the whole structure to prevent influence of heavy rain? (Lots more material, lots more work, high cost, rainwater harvesting potential).
- Paving slabs on their sides at the edges of the bays? (Easily available as many on site already, a bit of work, no cost, would also prevent rats burrowing in)
- Continue harvesting the nettles and comfrey growing at the edges? (Minimal work, roots penetrate the material itself in the bays, getting stung)
- Temporarily cover the edge ground with membrane to kill off the nettles and remove the high quality soil from the edges once the roots are killed off? (Temporary solution, very easy to do, would take time, could then involve paving slabs suggestion afterwards)

Obtain a Yield - this is the other obvious principle. The whole system is about generating a yield of compost. Both quantity and quality are key. The exploration of increasing the size of the last bay will potentially increase the quantity. The quality is, I think, already great as the material passes through both a hot stage and a cold stage. Further more it is not rushed.

Value Renewable Resources - compost is a great renewable resource. Plants are constantly growing, and so material is constantly available with just a brief slow down in winter. Animals are constantly pooing providing another key input. The last build involved wood and this time it will too.

Recognise Limiting Factors - there are a few limiting factors to consider. First of all the limitations on expanding the system. The system is squashed between the poly tunnel, a hedge and the [pissoir](#) (this link takes you to a design about the pissoir). There is potential to add an additional storage bay for horse muck and extend the last bay by about 2ft. These two potential expansions could be more than enough. Another limiting factor is time for turning the material but we have plenty of volunteers.

Minimum Effort for Maximum Gain - the main part of the system that needs rebuilding is the walls. The posts are tannelled and will not rot and are well in the ground and well positioned. Repositioning the bay or the whole system would add a lot of extra work.

There is the potential to move the pissoir further down the area although this would cramp it next to the hedge and lose a screened storage area. It would be far less work to work within the parameters of the existing space where expansion is limited but probably enough.

Earth Care - the alternative is fossil fuel based artificial fertilisers, a polluting non organic system. Making compost feels natural. There are many bugs supported such as worms.

People Care - the product supports healthy organic food for people to eat. It may also contain pathogens which hopefully are dealt with through the extensive hot and cold composting systems.

The process of turning is hard work and can be damaging for someone's back. Good tools, good posture and regular rests are required. It is good to turn it with someone else so conversation can happen, plastic can be pulled out and rests can happen.

Fair Shares - sometimes we need to buy in additional compost as not enough is being made on site. The bought in material is black, lacking nutrients and involves large machinery coming on site, often damaging a fence or gate in the process. The material comes from largely unknown sources so could be contaminated and involves big machines in its production. I would like to avoid these extra purchases and limit our consumption of that product. To do this we need to increase our own capacity.

Design

Dec-Jan 2021

I have made some key decisions in the design and rebuild of the compost system including:

- **Keeping the system in the same location.** It works well in its location and it is minimal work to tweak the existing setup. The rebuild will need to be done over a few days possibly spread over a couple of weeks as it is a living system. So as the build occurs I will also need to turn material to access spaces that need repair.
- **Using larch from on site.** Matt has some appropriate timber in stock and willing to cut more. There are plenty of lower grade planks mainly 5x1 of approximately 8ft length. I will use the existing posts as they are largely fine.
- **Extending the end bay.** Increasing the size of the end bay for storage of ready to use compost should enable turning to happen when turning needs to happen. Ideally turning should happen every 3 weeks rather than when the end bay is empty.
- **Start with the end bay.** By starting the rebuild at that end then I can very quickly increase the storage of the ready material and get it out of the way to give me access to other areas that need repairing.
- **Leaving the pissoir where it is.** There is enough room to significantly expand the end bay without moving the pissoir.
- **Get it done this winter.** The task is becoming urgent. On the last turn in early December the back of bay two fell to bits and had to be held in place with cardboard and props. Garden activity is low in winter and there is less pressure to turn the compost. It would also be great to have it ready for action in the coming spring of 2021.
- **Signage to chop new material especially long fibres.** We have many volunteers and they are not all involved in turning the material so don't understand the need. Despite instruction they often don't chop material. This can make the turning difficult. Hopefully a sign can fix that issue.
- **Use membrane at the edges to clear the nettles.** We have lots of ground cover membrane to suppress weed growth on veg beds that are not in use. This will take a year I reckon but then the rich soil and lost compost at the edges can be recovered and dug out. Previous attempts to dig out

the lost compost are restricted by the extensive nettle roots. I will then be able to add additional boards at a lower level and consider adding small upright partially buried paving slabs at the edges to prevent further run off.

- **Possibly create removable internal walls.** This is strongly desired by Beth. There can be technical problems though with this method. I personally have no problem shifting the material from one bay to the next but this can be work that is just too hard for some volunteers as it involves a lift and a strain on the back. The technical problem is simple. For this to work with ease then the posts must be slightly further apart at the top as compared to the bottom. This enables the internal wall sections to be lifted out easily. If the posts are perfectly upright or closer together at the top or both slightly skewed then the job becomes impossible or very difficult. Even when it is possible then I suspect that when the internal wall is removed that it might not be put back in the right way as each piece is likely to be a slightly different length with the shortest length at the bottom. There will also be a loss of strength between the front posts and the rear posts as they potentially are no longer tied together. So this requires some exploration when I start building. It may be necessary to fix the lowest section of the internal wall to tie the posts together. I will use 8x2 timbers to minimise the number of components and they will be marked to show their order, and only done when the posts are appropriately angled already.

Implementation

Mid Jan to Late March 2021

Tues Jan 12th

I was planning to not start the implementation until later in January but a number of limiting factors brought the start forward. There was the need to clean out the hen house which was done on Saturday and now means the first bay is pretty full. All of the other bays are also full and so there is no turning capacity. The compost toilet needs emptying desperately and the best place for its contents on this occasion is the compost system where further time for its decomposition can take place. The opportunity arose to start today as some other work due was not able to proceed and the weather was good. These various **limiting factors** on time seemed to conspire and make the focus on the rebuild clearly ready to happen.



Starting the rebuild showing the small end bay five and a wheelbarrow of tools

The tools I used included saw, impact driver, 50mm screws, tape measure, pencil, post driver, couple of posts, hammer, spade. I used a total of 13 boards during the day. The previous system was put together using nails but since then my preference has switched to screws as they can be stronger and quicker to use.

The day goes really well. As planned I start with the rebuild of the end bay. Two new posts are added, extending the length and depth of the bay. My decision making is intuitive about this as to where they exactly go. I know the boards I have available vary in length but are about 8ft. So I can make the depth closer to 4ft and line up the back post with the existing rear posts. I decide to leave a minimal gap between the pissoir and the new edge of the compost system, enough for storage or to just about walk past.



Two new end posts and starting to clad with larch boards, bay five material has not moved yet. You can also see the wall of the pissoir on the left

The old corner post is now in middle of old bay so needs to be removed (hidden behind spade in photo above). I decided to move it forward and create a half wall at the front which could use up off cuts of boards. This worked out perfect. A nice example of **produce no waste**.

The boards available, which are mainly 99-102 inches, can be cut in half to provide either the new end wall or cut one third and two thirds approximately to provide the new back wall with the off cut being used to provide the little wall at the front.

The capacity of the end bay changed from 85cm wide, 75cm depth and 65cm high (0.4 cubic metres) to 160cm wide, 120cm depth and 120cm high (2.3 cubic metres). This is more than a five fold increase and more than I had hoped for, giving us a massive increase in the potential to **obtain a yield** and the **removal of the key limiting factor**.



New bay five enlarged and the material starting to be shifted to the left

As I remove the old boards that have partially rotted I realise they can be dried and used as kindling for fires. I also notice that many of the boards in bay one do not need replacing yet. Both examples of **produce no waste**.

As the day progresses I shift the contents of bay four across into the new large bay five resulting in a clear space available between four and five. I was still uncertain about the plan to create removable internal walls as there can be technical problems as previously mentioned. Here though it will work and I find an old length of 8x2 which is perfect and can be cut up and held in place using some 1x1 larch sticks. Yet another example of **produce no waste**.



The first internal wall works to begin with but this one is not tied in

Sun Jan 17th

Another good work day developing and maintaining the compost system and I had help today from Lauren and Adam.



Start of the second day, finished moving material across from bay 4

We moved bay 3 into 5 and completed the top boards of bay five to make that completely full. This though caused, as possibly expected and now confirmed, a bit of outward pressure on the new internal wall and making the gap for the upper sections too big. This threatened to pop the internal wall parts out but it was too late to change them so some extra temporary braces were added.

For all the other internal walls I will be screwing the lower sections to the posts to fix them and prevent movement with only the top parts being removable. I also worked out a good way to mark them, by using the saw to cut notches. The number of notches can indicate which position and it's orientation if I always put them on top and at the back.

Bays 3 and 4 are now empty and the old boards in between and at the back have been removed. We also temporarily raised the walls of bay 1 to enable us to add in the compost toilet contents, which were already decomposed in the chamber for 6-12 months and will now be further rotted down as it goes through the turning system. We added the pissoir contents on top along with the horse muck.

Sat Jan 23rd

Day three of the rebuild, working with Lauren again. We built the internal walls between bays 3 and 4, and then between 2 and 3. For both of these we fix the lowest two sections with 100mm screws and ensure the posts are all leaning out slightly.



This is the internal wall between bays 3 and 4. These ones are fixed with screws. You can see the extra temporary bracing I had to use on the internal wall between bays 4 and 5 in the background

We also started to shift material from bay 2 into 3, and built the back wall spanning bays 3 and 4.



Here you can see the back walls of bays 3 and 4

We have a discussion about the internal walls and wonder if they will be much use at all in their new removable option. The thing is that the bay being turned into will be empty and the bay being turned will be full. Hopefully it will be possible to remove the internal wall sections straight away and that will make shifting the top half of material easy. But then to keep the material in the new bay, the internal wall sections will need to be replaced. At the end there will be the need to lift material from a nearly empty bay over a wall into the big heap of the next bay. The internal wall may help and hinder. We will just have to see how useful they are as we use the system.

Tues Jan 26th

Two volunteers complete the turn of bay 2 across to the new bay 3. This will allow the rebuild of the back wall of bay 2.

Tues Feb 16th

No work has been done on the compost system for weeks due to snow and ice. Today though I manage to build the back wall of bay two and start the turning of bay 1 into bay 2 carefully to enable access for the building of the internal wall between these two bays.

I also decide to use a spare off cut of plywood to make a wall at the front of the bay. This had been done for bays 3 and 5 as well and it was working well. This might become a new feature.

This delay of three weeks is fine as bay 1 contains compost toilet contents and we wanted to leave it there to do its magic. There are though signs of rats getting into bay 1 so speed is required now to disturb the blighters.



Starting to turn bay 1 into bay 2 and gaining access to do the internal wall

I notice that a couple of the panels on bay 5 have come away. The screws have broken presumably from the pressure of the contents. I have underestimated how much sideways force comes from a big pile of compost. I put extra screws into some of the panels of bays 4 and 5.

Sat Feb 20th

I turned a good chunk of bay 1 into 2, built the internal walls between the bays higher and added on some further height to the back of bay 2. I also added extra height to the wall between bays 2 and 3. Bay 2 is now full and covered for the first time in its new form. I add some extra screws into some panels, fix a couple of panels that had popped out in bay 5 and try to take a photo of the whole system. Finally I put down some black plastic at the back of the bays where the nettles normally grow.

Now apart from redoing the internal wall between bays 4 and 5, it is finished. I can't do this job until someone starts using the compost and emptying bay 5 which could be a whole month away.

I calculate that I have used 170ft of 5x1 boards and that bay 4 measures in at 0.7m³. So I know that every time bay 4 is turned into bay 5 we have generated that much usable compost.



New system pretty much complete

Tues March 23rd

Last week the end bay was started to be emptied and I asked the volunteers to empty it in such a way to give me access to internal wall between bays 4 and 5. Today I have been able to access and fix that internal wall. A volunteer was then able to turn bay 3 into bay 4. The system is complete and fully operational. Feels good.



Photo of internal wall between bays 4 and 5 now complete

We also have the opportunity to pick up horse muck later today so as planned I add on the extra horse muck storage bay next to bay 1. That just involves two posts and some side walls. This bay deliberately faces the track unlike all other bays.



Horse muck bay facing towards track

We get the horse muck and fill the bay. A great last day to sign it all off. I make a note of the turning and calculate the cost of the timber from our sawmill as £85. Probably also about £10 worth of screws but these were already bought in and spare from another job. What a bargain.

So it is done and I am rather rather pleased.

Maintenance

There's a few things I would like to consider for the maintenance of the structure and the system.

1. I will record the total volume output of material from the system. I have already measured the size of bay 4 and there have been three turns into bay 5, so this year so far we have produced 2.1m³. I am hoping that bay five will never be emptied.
2. I have tweaked my existing compost recording system to include total output this year.
3. I have also tweaked my turning record system so that the day that each bay was filled and covered is recorded. I want to ensure that each bay is turned after 3 weeks or as close as possible. This should ensure best product, highest quantity and minimal rats.
4. I will add extra screws in as needed to strengthen the boards as I am aware that the pressure from the compost has broken some of the screws.
5. At the back end of this year I will lift the black plastic behind the bays and dig out the excess leached compost and if possible add additional boards lower down. I have about 50ft of boarding spare.
6. The boards on bay 1 were largely ok so they have been left for now. I suspect I may replace them in a year or two as needed.

Evaluation

I will use a PMI again for this end evaluation

Plus

- Recalling lessons learnt about internal walls was great. Although I do regular building work, that work is varied and the last time I built compost bays was over five years ago.
- Having the new enlarged end bay is great and is already liberating that limiting factor.
- Completing the rebuild is most satisfying. It feels better than ever and should last us a good few years.

Minus

- It was tricky to rebuild a system whilst it was also in operation. This took some timing, planning and careful moving of material. All possible though, just required care and patience.
- Having to fix and add extra screws to some panels after the sideways force had pushed some panels out.
- The internal walls were a bit of a faff and I am not convinced they will make a big difference to the turning ease.

Interesting

- I wonder if the removable internal walls will increase ease or be problematic. I still have doubts. An evaluation of that is required at a later date after they have been used a few times.

Reflection

- Really pleased that I managed to record this design and build. That has been made possible by my Routine Design which builds in at least 30 mins for design work every morning. Like all of my designs since the start of 2020 this has been written using Evernote. I hope to be able to use this design as teaching material for future permaculture courses.
- There was clearly a moment where I had not done enough analysis regarding the internal wall issue. Although I had thought there would be problems with it, and had vague recollections of what could go wrong, I still ploughed on with it. This would have been a good moment to ask Matt for some advice in advance rather than just seeing what would go wrong.
- There is regular and extensive use of the principles here in this design. Compost and principles go so well together.

Further Tweaks, Evaluations and Reflections

Written after May 2021

- Rats occupied the large bay 5 from March 2021 through to Summer 2021. As the bay was so large it was not fully emptied until about May and I could see right at the bottom there was a comfortable rat nest. I could see signs of this nest externally from compost that was being dug out at the rear but there was nothing I could do about it until the bay was emptied. I did though continue with rat trapping at the rear of the compost area throughout the summer period. I have a very particular [rat catching method](#) that I devised some years ago and became a handout for others suffering.
- The internal walls proved popular with volunteers enabling at least a bit more ease with some of the work as the top half could be shifted across more easily. In some cases the internal wall sections became too big as I suspect the back wall moved backwards creating a larger gap for the internal walls. I added on some additional side supports so that the internal walls still fitted.
- The front walls made of plywood were great to begin with as a big strong wall to retain the material but these needed to be screwed in and unscrewed every time we turned from one bay to the next. In Sept 2021 I came up with a tweak to add on loosely fitting turning handles that could hold the boards in place and no longer required the impact driver and screws. This was super useful for more flexibility for volunteers to turn the compost without relying on a tool that I could be using somewhere else or stored far away.



The new turning handles on the front

- The black plastic at the rear of the compost area proved really great by suppressing the nettles and creating a clear space for me to set rat traps. I checked the traps once a month, sometimes once a fortnight and every time I was able to clear the spoil that they had removed and lift the black plastic and dig out some of the rich dark soil underneath and get that into the compost system. After a while I was also able to add on more boards to the back wall of the compost system at the base.



***The rear of the compost area covered in black plastic and tyres.
Over the summer I added rat traps to this area and continue to do so***

- As of the middle of November 2021 my records show that we have generated 7.7 cubic metres of compost this year since records began in mid Jan this year. There is potential for two more turns before the year is out and thus a potential total production of over 9 cubic metres of compost in 2021. This amounts to 13 turning cycles, an average cycle of 4 weeks. Delays occurred at times due to holidays and due to lack of tools in the right place at the right time and sometimes no one to do the job that particular week. Each time a date was set to turn a bay 21 days after it was filled but sometimes that meant that date landed on a non work day or day when no one was around to turn it. That could easily result in a lost week. The quantity generated is far higher than my estimate of the previous systems output of 4-6 cubic metres. But I am also certain that I can increase it further by proposing that the turning cycle is 18 days minimum. That way it is more likely to actually be turned within 21 days each time. If turning does occur every 21 days then there could be as many as 17 turns a year which would generate closer to 12 cubic metres of compost a year.