In short if you are always just reacting (or if working in a pair not considering how your partner might respond) to earlier stone placement then at some point you are likely to create jointing issues. A bit of thought can reduce or even remove this potential. Also think about what you place alongside your long stone, leave enough space to get better stones on the far side if you want to mitigate against the likelihood that you have to trace around the longer stone. Ultimately you can always try trimming the back of the stone to make it easier to build around. If you leave it, it will not get shorter by itself (well it might if the elements are left to act on it for several hundred years) and if you are building your wall in an even sequence then it will be the same length further along and likely to lead to similar problems and get left out again. If you leave it out and plan to use it further on along another section, then when you are doing that bit don't leave its use too late. This often happens with longer stone which have relatively small faces (compared to their length), they just keep getting left as their use at first seems inappropriate and as the wall grows, becomes too difficult. We shall return to this problem in a few paragraphs time.

In some ways related to this length/jointing is the placing of throughstones. Ideally with a throughstone you want to have two joints opposite each other in order that the throughstone sits well. I think most people just trust to luck and do not really consider this. Usually I work out where the throughs are going to go, easily done if they are at regular intervals and nice and flat, build one side, mark the position of the throughs and go around the other side and build it so that the joints line up. Not so easily done with irregular stone, or where the throughs have to be placed according to length (i.e. do not project), and even though you are trying to space them regularly still need to go more where they want than just being forced to sit at regimented intervals. In these instances I tend to build one side and place the through, propped in the middle of the wall, before the other side is built. I can then see how to build the other side to specifically take the stone (as described in *Stonechat #12*, Summer 2007).

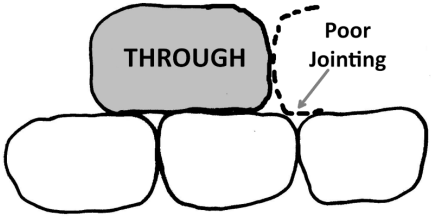

Fig.2. If placed close to a lower stones edge, a through can create problems for crossing the joint with the next stone

Whilst having joints opposite each other is a step in the right direction, it is not the be all and end all. You should also be considering how the through will overlap the joint in the face, there is no point creating the joint with two stones with the through lining up with or close to the edges of one (Fig.2) or both. Throughstones do not only tie the faces together they distribute loads. Placing a through and then creating a running joint, which can concentrate rather than distributes loads (as we saw last time in part 4), in the very least partly negates the good the through does. It is (all other things being equal) probably better to have a through with a joint than no through at all, but it is of course better to have the through and no joint, which with forethought and planning should always be achievable.

Another consideration here is that you can also place the through on a longer stone rather than over a joint (Fig.3). This stone will almost inevitably be traced, especially if you leave a good amount of it on which to build either side of the through (depends on the width of the through of course). However as one of the 'rules' as to what to do if you 'have' to trace a stone is to tie it back well into the wall, you can hardly tie it back more than have a through sitting on it! Here we have a compromise that we are in effect immediately strengthening. Consequently it is not necessarily a criminal offence as long as we are mitigating the compromise, in that the traced stone sits well, that the through sits on it well, and that there appears little chance that the through will act to displace it. Bear in mind that a through gathers and redistributes forces, so it could (I think) actually be placing more load on the traced stone than might otherwise be the case. Not necessarily a problem if the stones are working in unison given that it also holds it in, but not if you are piling compromise upon compromise.

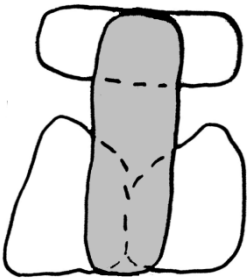

Fig.3. Throughstone sitting over joint and traced stone

One final thought here, relating to the placing of loads with throughs, and particularly related to the use of awkward shaped stone. When the through is placed it should sit well and not displace the stones below it at all. If they have a tendency to move when you place the through (even if it is to reach some form of apparent equilibrium) you are likely on a slippery slope once a greater load (i.e. the rest of your build) is placed on the through.

Having mentioned grading in the last edition, with particular reference to the effect poor grading has on jointing, (and in part one as a general concept) there was another aspect I decided to postpone at that point. This possibly only has a tenuous link to planning, but here we go none the less, grading is not necessarily all about sorting by face height but also in effect by stone volume. Here we shall look at two specific problems stones which have large faces with a bit of height but a short length going into the wall, that is they only stretch into the wall the same or maybe a little more than stones which are much shorter in terms of height (hence their volume is closer to stones with smaller faces which stretch further into the wall), and those stones which are relatively thin but have considerable length into the wall (that is stones with high volume relative to face height - a particular problem with slate and similar, especially in a mixed stone wall). Those with a very long memory might remember seeing something about this when dealing with slate way back in *Stonechat #8* (March 1995).

A tall stone of a given length will have a higher centre of gravity, and so will be more prone to displacement... all other things being equal (ceteris paribus) - I hope you remember that phrase and the reason I use it (finally explained in the last edition), than a shorter height stone of the same length (Fig.4.(a) and (b)). This can be particularly problematic if the height is only slightly less than length into the wall (Fig.4.(c)). One reason we place stones length on is because for any given width and height/thickness their centre of gravity will be further into the wall (Fig.4.(d) compared to (b)). This is a minor consideration compared to length in meaning the stone has to move further to be displaced and if we run most stones in that overall there more stone in the wall to be held to be held. It is not that likely that a stone will actually topple, but the principle that it is less stable than it might be holds true and so it could be MORE stable and hence better. This might be a relative minor consideration when dealing with nice regular flat bottomed stone for diagramatice purposes (and in practice), but once the stone becomes irregular or worse still slightly rounded then wobbles can set in, and the greater the possible wobble the greater the potential for movement. Space does not allow me to go further into the relationship between the centre of gravity and stability, suffice it to say it should go without saying that tracing a stone which has a height similar to its length is an extremely bad idea.

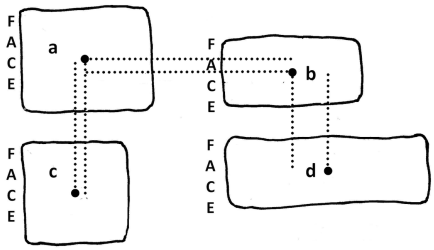

Fig.4. Relative centres of gravity.
Dot is approximate centre of gravity, relative to face; lines are to help show relative positions.

As long as the stone is length in then it is potentially as stable as it is going to get, however it might be that it should be placed higher in the wall than would be the case as dictated by face size/height alone. Higher in the wall there should be less force acting on it's relative instability (that all other things thing again) than if it was placed lower in the wall. Provided it is not creating jointing problems, nor compicates building alongside and it sits well then maybe it is better higher in the wall, alongside stones of relatively similar length into the wall rather than alongside stones of the same height. If it is used lower in the wall then it needs to sit really well reducing the displacement potential, good jointing and contact alongside should also be aimed for and ideally it will be solving a problem or facilitating a solution. Thus you are mitigating the weakness using the stone to its best advantage, and not piling compromise on compromise creating potentially greater weaknesses.

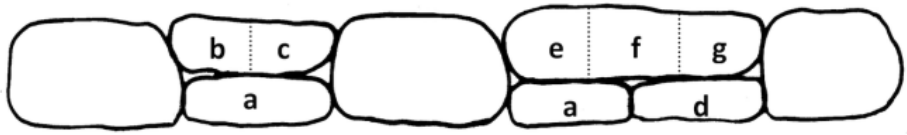

Fig.5. Thin stones placed alongside thicker stones can create a number of escalating problems

Thinner stones with good length present a similar grading problem. If you place them high in the wall alongside stones of similar thickness, their length can make them difficult to build around causing a number of compromises. Placed lower in the wall they are potentially more liable to fracture and they will also usually need to be built on with 'smaller' stones to bring to a level alongside whatever is the 'norm' for this height in the wall. In Fig.5 we can see the sort of problem encountered. The thin stone (a) placed alongside a thicker one requires either two small stones (b,c) to bring it up to level, or (bc) could be a single stone which would create a relatively unstable stack, although it might reduce the jointing problems from

trying to build on b and c (as described in part 2). Placing another thin stone (d) alongside (a) increases our options. If we are extremely fortunate we can find a single stone to create (efg); more likely we have to use two stones either (ef) and (g) or (e) and (fg). As we have seen previously (parts 2 and 3) this can lead to clustering as similar size stones flock together, and you end up with a number of apparently undersized stones low in the wall (especially if e,f,g are individual stones). Again there can be jointing issues as discussed in part 2. If these small faced stones have good length comparable to their larger neighbours (and decent internal contact) then the clustering it's not necessarily that much of a weakness. However there are effectively more moving parts lower in the wall which, all other things being equal, is a potential weakness. As ever if you are aware of this and build accordingly; mitigating weaknesses; avoiding the piling of compromise on compromise; improving upon rather than exacerbating the problem; then ultimately who's to say what is best, lower or higher? If we break it/reduce length would the smaller bits lead to a better wall? Does its length utilised high up stabilise (tying) or destabilise (lack of space opposite)? What is the knock on effect?

At times we are probably playing a guessing game. You might have noticed that earlier with the shorter larger faced stone, I only said these stones 'might be' better off higher up the wall. There is an argument that if a wall moves in its base then this movement can be magnified as you move higher up the wall in which case its relative instability might have been better off in bottom. The bottom line is that neither is ideal and so whichever you choose then it is best to make an extra effort to do it well and avoid further compromise.

Another consideration with a thinner stone placed lower in a wall is whether or not it will crack and if it does will it really matter? An 'interesting' debate this one (hope you're all wearing your anoraks). It depends on stone type, the actual thickness, how it is sitting, how things sit on it and how things line up (this was to some extent dealt with in part 4, if not quite in this context). It's essentially about pressure points and loading and not exactly easy to predict. The better the crossing of joints and the better the stone contact (flat stone on flat stone should have far fewer problems than flat amongst irregular for example) then the less likely the problem, so again work to mitigate the 'compromise'. Meanwhile developing the argument, if it does crack then there could be potential problems. The crack is likely to appear alongside a pressure point (it can be away from this point if there was already a weakness in the stone), point loading often occurs at joints (or is created by other irregularities) and so you are likely to create short running joints, whatever happens you are likely to have worse jointing as a result. It is also changing one stone into two or more and so you have additional potential moving parts at this point in the wall. So if a stone does crack then that piece of wall is likely to be potentially less stable than it was.

There are too many variable to be sure what will happen, back to our guessing game. However in the very long run it would (all other things...) be less likely to outlast the 'same' wall where this was the only effective difference.

This is the crux of the ceteris paribus point. We cannot be sure what will happen, but if our 'weakness' is the only difference between two pieces of wall or two stones (regardless of whether or not it is actually possible to be the only difference) then one will be weaker and if we know that we should work to eliminate that 'problem' if we want to build a better wall because of the very same point... we cannot be sure what will happen.

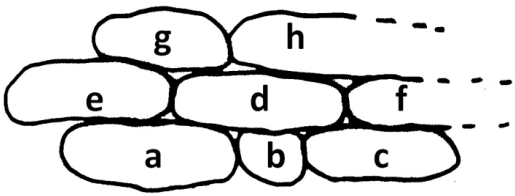

Fig.6. Placing a 1 on 3 might only be the start of problems

We have seen that 1 on 3 is a problem and one that cannot always be avoided, thinking ahead and planning reduces its occurrence but in terms of overall planning if we cannot avoid it then the compromise should be planned reducing the potential for compromise on compromise creating a bad weakness. One on three has the habit of escalating as a problem, (as do stone size and jointing issues). Even at its simplest 1 on 3 is a set of 4 stones which have to work together, but you also have to consider what goes on alongside these and on top of them in the end you have 8 stones that you need to get right without adding compromise to compromise. In practice (moreso if you react rather than plan) the biggest problem of the one on three is finding a (d) which sits, and often in order to do so it does not lap far onto either one or both of (a) and (b). This can have knock on effects along and up. For example we sort out our one (Fig.6 (d)) sitting on 3 (a,b,c). Where the ends of (d) sit on (a,c) affects the placing of (e & f) in terms of their size and

width. The relationship (a,e,d,g) is the ideal (if we are not careful the same problems, or variations thereof, we have with (h,f) could of course happen on this side). However (f) has to be either have a narrow face in order that it does not reach the right hand end of (c) and leaves enough space for a good overlap subsequently; or it has to stretch beyond the end of (c) sufficiently not to just push the jointing problem further along. Then in turn the width of (h) will be partly determined by how far onto (f) we want it to sit. If (f) is narrow we will have little room for manoeuvre with regard to jointing, if it is wider then (h) will need to be wider or just recreate the same problem on this layer... mushrooming along and up (see part 3). Just as when placing (a,b.c) we should be thinking of (d) (see part 3), then ideally when thinking of (d) we should be considering what comes after it. Which option for (f) might we choose, do we have a potential (h) for whichever option we choose. In fact do we need to re-think (d). The less regular the stone, the more variations, difficulty and options there are. Not sure if that makes it easier or harder! With experience much of this becomes easier, even intuitive. Even if you are not directly thinking about it being aware of the process and potential for problems should mean you are less likely to fall into any severe 'traps'. As you aim to learn and improve it can be daunting, it is often difficult to appreciate what the problem you are creating is when you create it, only becoming apparent when sometime later you try and build on it.

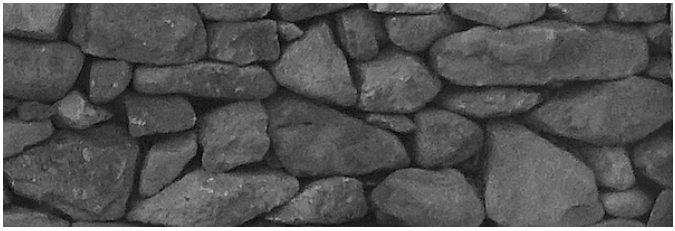

Fig.7 (Above). The stones alongside the 1 on 3 in the centre have created all sorts of further problems.

Fig. 8 (Right). Above Right, how it should be done with the top 1 in 3, unfortunately the lowest 1 in 3 has led to another 1 on3 immediately alongside it which in turn has led to the top one in three. I'll get my coat.

In essence if you cannot avoid the problem at least try and think about it. Here with our 1 on 3 for example think... am I creating a group of 3 that I can a stone on and cross the joints sufficiently not so little (a compromise itself) or so much that it becomes difficult to cross the next joint. Not only that but these stones and the one of the one on 3 will have to be built on. Try and realise where you have a problem and not compound it. Here take extra care not to create further problems such as steps or face length that will make subsequent jointing problematic. The 'one' is often long which can cause problems with small overlaps or even the need for another small stone and another potential one on three. Think what sort of stone will avoid these problems, do I have this, will I have suitable stones to go alongside that etc. Can I avoid compounding the initial compromise and if not can I do it a slightly different way even if I cannot avoid it.

Related to the one on three problem, which often takes the form of a small stone between two larger stones, is the use of relatively small stone in general. Often small gaps are created by building out of sequence, by placing stones that sit well over a joint then another often by just picking a stone up and putting it somewhere because it doesn't fit where initially intended, rather than putting it down again. The main mistakes here are to leave gaps that are too small and then just putting a small stone in it. It is usually harder to leave a slightly bigger 'medium' sized gap (depending on overall stone size/available choice) and find a stone to fit it. I think that better and/or more experienced wallers often have a better feel for whether or not there will be a stone for that specific gap, in some ways planning (albeit often intuitively). There is also a tendency when you've just put a stone on the wall because you'd picked it up and that's where it sits, even if that is several feet from where you intended, that when you try to build up to it, you get close and then can't quite fill the last gap and so a 'small' stone gets used. Really you should be removing the stone you placed minutes (hours before) if you can't get everything to work together. There is little wrong in leaving a stone to rest somewhere, under consideration so to speak, but it should not be 'set in stone' (sorry). If you need to move or remove it in due course then do.

Figs.9. (Above) and 10 (Below) are sections of the same wall built by different professional wallers. They are built at the same time from the same stone and seem to suggest very different thought processes

Where this over reliance on smaller stone is due to concentrating on crossing joints, and avoiding running joints we have to ask is that better than a joint. I'm not sure there is a definitive answer as its likely to be reliant on so many variables. So the occasional one is possibly no worse than a two stone joint but when it becomes common place then it surely must be a weakness. It also shows either a poor process or a lack of thought or both

Whilst we're on small stone where they are part of a recognised (usually localised) pattern or style pins and shims are normally regarded as poor practice. Both are stones which are relatively very small compared to the stones around them. Shims are thin stones used to level between two adjacent stones which have a small step between them. Large/thicker shims are plates and another issue (the thinner stones in Fig 8 are generally plates rather than shims), obviously some of the aspects about to be discussed here will apply to them but they are usually more or less building stones in their own right, whereas shims tend to lack substance. Pins are small stones inserted between larger building stones and often irregularly shaped.

Fig.11. Shims, more shims, pins and shims as pins. Welcome back the wall that kicked the series off

If we return to the first picture shown in part one (Fig.11) to illustrate an apparent lack of planning we have all sorts of pins

shims and plates, even rows of shims supporting large stones. We also have small building stone in gaps between probably built rather than inserted and whilst technically building they too are often referred to as pins although generally a pin would be stopping a wobble or filling a small void. This difference is better illustrated by Fig.9 which has some shims but most of the small stones are filling voids rather than actually pinning the building stone. In Fig.11 it is likely that many of the shims are in effect pins, not levelling, rather an attempt to stabilise an ill fitting, poorly seated large stone.

The need for a shims often occurs because haven't looked far enough ahead to the extent that you have left a step. As with most things walling the occasional one might be acceptable, their presence in numbers suggests the builder is not thinking or has faulty thinking in that even if they do not know it is a weakness they tend to build and react rather than plan.

If a shim is used then it should have good length into the wall and very good contact above and below. Any pressure points and it is likely to fracture, becoming even smaller and potentially more likely to be displaced if/when there is any movement.

Both shims and pins tend to be used after we have tried to place a building stone and it doesn't quite fit or sit, in order to make it sit/stabilise it. If it is the one shim/small stone you are going to use this week (I'm being mean, one a day maybe) then really you should remove the building stone and use a shim/pin that has good length and sits in its own right - build it and replace the bigger stone on it, rather than just stick it in. A shim or pin should never simply be inserted from the outside and entirely reliant on the stone it is supporting/stabilising to hold it in place; it only takes a small amount of movement for such stones to become loose or even displaced. As every compromise they cannot always be reasonably avoided. The odd one here and there is not necessarily a disaster (although all other things being equal a wall without them should be stronger), walls riddled with them are likely to be unstable in the long run once the wall starts to move, however solid they seem when first built.

Trying to assess the long term effects of anything we do when walling, such as whether placing 'short tall' stones near top, or thinner stones in the bottom will always be best I have compare to being something of a guessing game because of all the potential variables. We can never be really sure of, or accurately evaluate all of these variables. What if we build the perfect foundation and one section proves to be on (not obviously) softer ground, We might have been better off putting all the good foundation stones in that one section, rather than trying to build consistently by mixing things up. However it is just because we don't know what will happen that we should try to build consistently and try to appreciate what might happen, how faults interact and how problems create further problems. The variables are so great that we cannot eliminate every problem or safeguard against every eventuality but by understanding what is going on we trust less to luck that the wall will stay up. A wall might fall down because one section is on different ground conditions and we built a consistent foundation, but this will be the exception and by building consistently and eliminating those problems we can, then overall in a lifetime more of what we build will have a greater chance of standing up and standing up for longer too.

It is sometimes said of my writings and the *"Stonework"* booklet in particular that worrying about all these things means people grind to a halt, and can never really progress because they are worrying about everything. To some extent this can be true, but essentially it misses the point. No-one gets everything right, if you know something is wrong you can reduce the problem, you only grind to a halt if you try and eliminate everything which is not what walling is about. In fact however hard you try to eliminate everything generally you still get something wrong, you just might not be aware of it. To a certain extent you need to let go and get on with it, but those that do that without understanding or appreciation of their errors will inevitably build something that will fall down or in the very least not last as long as might have been expected. Let the rules inform you not put you in a straight jacket, compromise can be a good thing, if it is informed compromise.

Some might argue that many of these faults are only perceived faults and essence not necessarily that much of a problem. However to my mind that something is a fault or could in the very least be improved upon should not be a point of debate... it's a fault. The importance placed on it is another matter and that can come down to whether or not here, today, at that point on this wall, with this stone, as to whether or not it is of any significance. It can be impossible to evaluate, back to the guessing game, but if you know it's a potential problem then at least you can make an informed decision and live with it. If you want to improve you have to be able to see and appreciate what can be improved upon, the worst wallers can rarely see their faults. If the perfect wall is nigh on unachievable then we can all improve whoever we are, as long as we can see and understand how to improve.

.... from p2... Then I saw another photo and got a sense of perspective. Now I think it might last. This wall is part of a pathway at Venus Baths,in the Grampian National Park, Victoria, where Gavin also built a dry stone bridge. You can see more at Gavin Rose's website www.gavinrose.freeservers.com/index.html. Gavin certainly likes his large stone as can be seen in his article p.13. Photo courtesy Gavin Rose.

the Dry Stone Walls Association of Australia

The Flag Stone

Issue No. 34, September 2015 Patron: Lyn Allison ISSN 2204-8316 Editor: Bruce Munday

DSWAA Builds, Meets and Dines Out

By Lyn Allison (DSWAA Patron) and Bruce Munday (DSWAA committee)

David Long (l), Alistair Tune and wannabe wallers with the product of their labours at Camperdown Showgrounds

The DSWAA held its eleventh Annual General Meeting on Saturday 22 August at Camperdown in western Victoria.

A highlight of the day was at the showgrounds where seniour dry stone wallers, Camperdown's Alistair Tune and David Long from Melbourne, built a double wall from local basalt. The wall, about 10 metres long and 1.2 metres high, is in the traditional style of the Stony Rises. It will progressively be added to in classes conducted by Alistair and will become a feature of the showgrounds. Enthusiastic members donned gloves to help build the wall and learn a few tips from these master craftsmen. A steady procession of locals and visitors also watched the proceedings, retiring occasionally to The Shed for refreshments provided by the Pastoral and Agricultural Society.

About 40 members attended the Annual General Meeting later in the afternoon at the Commercial Hotel. The Annual Report and Financial Statement for the year to May 2015 were presented and adopted, along with an acknowledgement of the great work of The Flag Stone's long-time editor, the late Charmian Brant.

The meeting was followed by a dinner with guest speaker Sara Jane Peters, heritage advisor to the City of Melton. Melton was the first municipality in Australia to conduct a comprehensive survey of its dry stone walls and is now in the process of amending its planning rules to protect the best of its extensive dry stone walls. This very noteworthy initiative is documented on their website and should encourage other local governments to formally protect their dry stone assets.

THE FLAG STONE, ISSUE NUMBER 34 <1>

The Dry Stone Wall Association of Australia website www./dswaa.org.au/ has changed a bit since it was first mentioned in *Stonechat 14* (Winter 2008). It seems to be under development but does include umpteen back copies of their interesting journal "The Flag Stone". Well worth a look.

The photo below is from the website and shows an Irish Feidin style wall nicely Austr(al)ian. This one is actually at Camel Hump (Mount Macedon, Victoria).