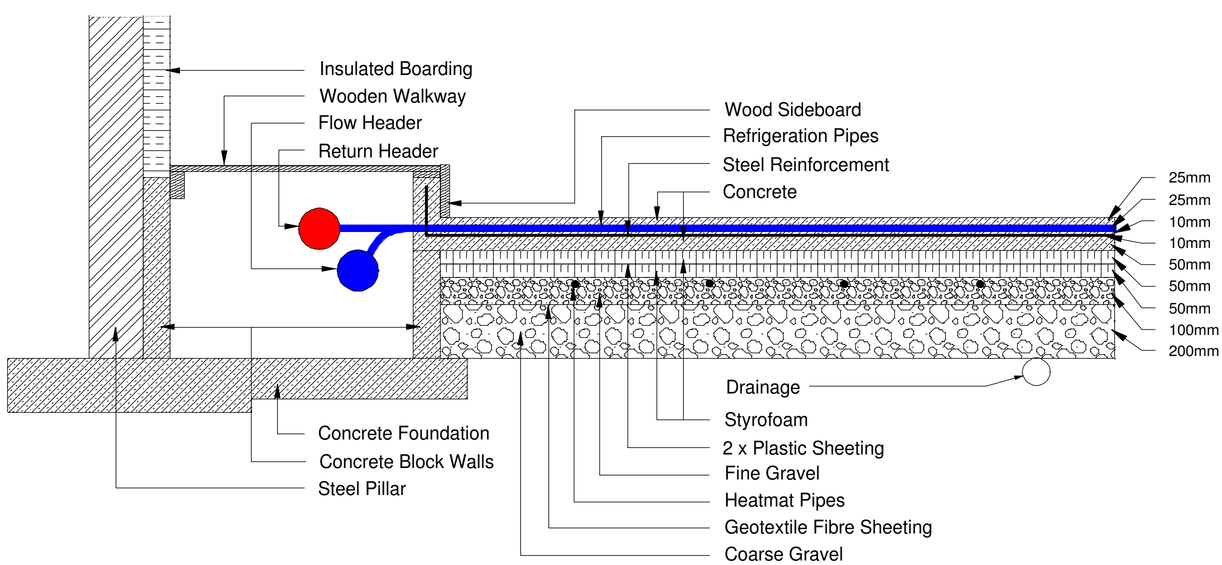
PLANNING

Although curling rinks are relatively simple buildings, the use of water within them creates substantial problems. Working with water in all three stages of gas, liquid and solid requires careful control of the environment, which requires a good building with good equipment, which requires a thorough understanding of what goes on in a curling rink. The cost of energy complicates the issue, whilst also restricting the amount of cash available for repairs and/or improvements. It is therefore no surprise that most facilities struggle not only to maintain what they have, but also to find the information that will help with their planning for the future.
We as a group have spent many, many years studying the various aspects of curling ice and the curling environment, yet we still need to spend many more, because we will never have all the answers. We have a policy that we don't publish information unless we are sure of the facts, yet even then the facts are only what we have acquired from others and can't always test as we would wish. But we will try, and learn as we do so, and assure everyone that everything is an act of faith, if not fact.

<u>1. A new curling rink</u>

Very few people will ever have the luxury of building such a thing, yet many ask the question of how to build a modern curling rink. We too have studied the matter and have discovered, not surprisingly, that precious few people know how to build a modern rink. The knowledge is available, here and there, yet too often the project is handed to an architect who knows nothing about curling, and he will deal with engineers of various fields who also know nothing about curling. It is a dangerous business. The information given here is based on what we have learnt in our efforts to build the Circle (Curling-Ice Research Centre for Leisure and Excellence), which is the simplest way we could devise for building a curling rink that can do its job and be most cost effective to run.
The floor is now very much a standard design. The aim is to provide a level surface that is refrigerated and insulated, to withstand changes in temperature from say – 10ºC to + 20ºC or more, in the shape of a shallow dam that will contain water in either liquid or solid form. The diagram below also shows the header trench down one side, meaning that the pipes run across the floor from side to side and not down the length.
The distribution of secondary refrigerant is a new design. It is our belief that the DDF system (Dual Diagonal Flow) will work best for curling, where the secondary refrigerant will be supplied to two diagonally-opposite corners into the headers and be removed from the opposite side – there are no return pipes under the floor. The flow headers will supply the pipes alternately from both sides straight into the return headers. This will ensure the most even distribution of refrigerant and so the most constant temperature in the floor.
With modern laser equipment it is now possible to achieve a level for all the layers within 5mm over the entire floor, and this is very important. Our advice is to use only the very best flooring specialists who will have the equipment and expertise, because the floor cannot easily be changed.



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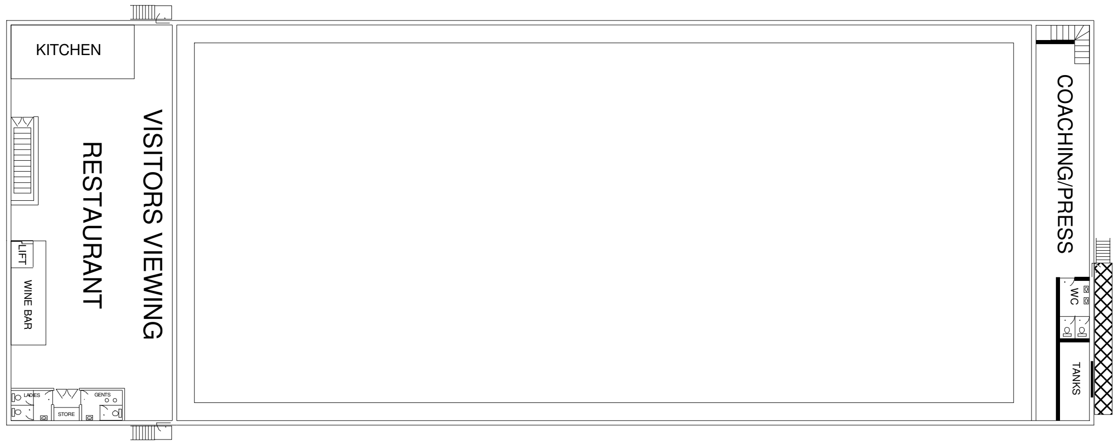
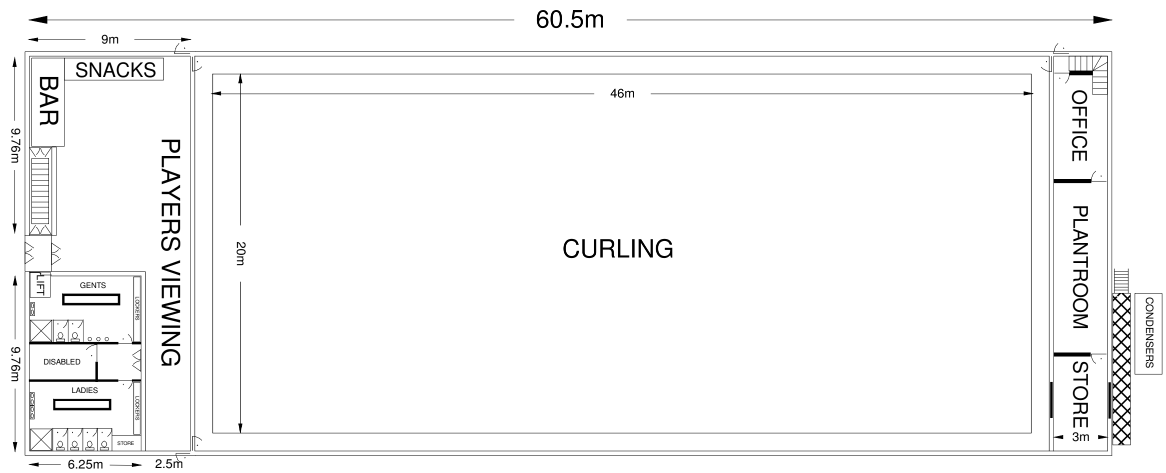
The building itself will be decided by the number of sheets of ice and further requirements. For a simple four-sheet community rink the diagrams below give a rough idea. A variation of this simple plan can be found at http://www.scottishcurlingicegroup.org/circle/CirclePlans.pdf





The building is essentially a simple steel portal frame covered with a roof and outer walls, probably of concrete blocks. Inside the building is an insulated box constructed of insulating panels (100mm should do) that will create a sealed room, totally sealed, so that nothing can come in or out unless required. The viewing areas act as air locks and the atmosphere in the rink is controlled through the dehumidifiers and air conditioning. The Circle plans include a substantial heat store that will hold all surplus heat from the refrigeration plant and, with the help of a boiler, provide all the heating requirements. This "box within a box" will allow the operators to maximise energy savings and minimise the migration of moisture from outside, whilst providing the optimum conditions for curling ice as a matter of routine.

Rainwater from the roof can be collected in a large tank of 30,000 litres, which is sufficient to install the ice with the cleanest free water there is. If mechanical dehumidification is used there will also be sufficient quantities of distilled water for pebbling, or a small deionising unit can be used – our own preference is however for desiccant dehumidification, using two smaller units rather than one large one, which will allow one unit to be used for humidification if necessary. It is important with this design to give careful consideration to FAQ (fresh-air quality), ensuring that clean air is dried and introduced into the building as required. A competent air-conditioning engineer will be very useful.

The curlers are the customers and their needs have to be supplied. Also, there must be sufficient numbers of curlers to make the facility pay, and as a rough guide that will mean at least one hundred regular curlers per sheet of ice. It is financial folly to think that an "estimated" number "might" need extra sheets of ice, simply because the board is thinking of hosting a major competition once in ten years – the bills will be paid by regular curlers, not competitions.

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2. An existing facility

This can be anything from a Quonset hut to a glass palace, and a new building is not an option. There will be problems everywhere from a leaking roof, insufficient dehumidification, no heating and old plant, to stones that won't curl, staff that know very little and curlers who always know more. Welcome to curling ice.
The equipment must be able to maintain the required parameters of temperature and humidity within very small margins, and absolute cleanliness. Often this is not the case, and it is not always easy to identify the cause of a problem. There are usually so many problems that it can take years to find the answers, and without careful planning it will be impossible.
Heating can be a confusing business. It costs money and doesn't really deal with surplus moisture in the air. In many rinks freezing and heating cannot take place at the same time, because the compressors can't cope during installation – only when the floor is frozen solid can some heating be introduced. Someone says it is too cold and the heating is switched on; someone says it is too warm and it is switched off. Consensus has established that an AT (air temperature) of + 7ºC is ideal, and that this should be measured at 1.5m above the ice surface, and there should be accurate equipment available to measure this.
Humidity too is often misunderstood. For instance, high humidity within the rink is usually blamed on an inadequate dehumidifier, yet the holes in the wall or roof that allow humidity to enter the building are ignored – it takes only a very small hole to upset the balance, because water will always migrate to the drier environment. Again, accurate equipment should be available to measure what goes on here, and the simplest to use will be wireless thermohygrometers at different levels in the air space. In the table below three such units were used, with these results taken from a log during a normal game.

Height	% RH	AT in ºC	DPT in ºC	HR in g/Kg
1.5m	75	9.2	4.2 – 5.0	5.42
3.0m	65	11.0	4.0 – 4.6	5.29
4.2m	56	13.5	4.5 – 4.8	5.38

Note that as the AT rises the RH falls, whilst both the DPT (dewpoint temperature using two methods of calculation) and HR (humidity ratio) remain much the same. The HR represents the actual moisture content of the air as grams of water in Kilograms of air, and shows that this is the same throughout the air space. Surplus humidity can be extracted at roof level, which will also extract surplus humidity at ice level, because the surplus will migrate to the drier environment in an attempt to equalise the HR. See the report on *Water In A Curling Rink*.
Dealing with equipment requires two things: knowledge, and support. To increase your knowledge, learn what the thing is supposed to do and take steps to see if it is in fact doing so, take measurements, ask advice, search the internet. To ensure that this knowledge does not go wasted, get the support of the board, the owner(s), the curlers, the manufacturers and suppliers. The process will take time, but there is no simpler way. Some items will need annual investment, such as servicing of the refrigeration and dehumidification plant, blade grinding, pebbleheads and so on – these should be in the contract to avoid arguments, delays and disasters. Other items will be occasional upgrades or replacement, ranging from a few pounds to a few thousand, and requiring considerably more knowledge and support. At all costs avoid the scenario of buying something simply because a salesman says you need it.
The building is usually a very difficult subject, because it is in place and cannot readily be changed. Usually a curling rink will struggle because there is insufficient revenue and therefore never enough money for improvements, but a well-presented case – suitably supported by data and evidence of the benefits – can often reap rewards. For instance, if there is insufficient dehumidification because the roof leaks like a sieve, log the hours needed to run the dehumidifier and compare this with the specifications that will say how many hours the dehumidifier should be running – having the roof repaired will not only be cheaper than a larger dehumidifier, it will also save money by running the dehumidifier for fewer hours every day, every week, amounting to thousands of pounds by the end of the year. An hour every day amounts to two hundred or more hours over a season.
The floor is potentially the biggest problem, especially if it is a sand floor with old piping. Replacing the floor is seen as a costly business, yet it is the most important part of the facility. Instead of messing about by spending money on repairs that will not really solve the problem of old age, obtain some estimates and build a strong case for a new concrete floor, with new pipes and headers and a trouble-free future for at least twenty years. With the support of those in charge it will be possible to convince the customers that a fundraiser is a good idea, and if the bank will help to spread the cost over a few years the floor will be affordable.

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Air movement must be taken seriously, because it can easily become a serious problem. It is best to remove and introduce air as high as possible in the building to avoid turbulence at ice level, and this is not always easy. By using ducting, which is not terribly expensive, the air can be removed from anywhere, and careful ducting with several outlets can minimise the damage caused by introducing high volumes of air through one outlet. For instance, air blasted into a corner will be forced down the corner to hit the ice surface in one small spot, which will soon melt and be difficult to refreeze – many will think that this spot has been caused by faulty piping beneath, unaware of what warm air can do.
Something also often overlooked is the effects of glass in the walls, especially in the sides of the ice hall. Warm air rises and colder air against the glass falls, causing a draft across the ice surface adjacent to the glass which shows as heavily frosted areas. Glass at the ends is less of a problem because it is usually warmer (thanks to the viewing areas behind), or further from the ice surface. In fact, any surface relatively colder than the air temperature can cause this, and the result will be that the ice sheets will sublimate next to the sideboards and become lower.
False ceilings are usually recommended and installed to prevent heat radiation from the roof. It is true that in a curling facility these can make a big difference, but it is not clear just how big. Wikipedia provides some information:
Radiant barriers or reflective barriers inhibit heat transfer by thermal radiation. Thermal energy may also be transferred via conduction or convection, however, and radiant barriers do not necessarily protect against heat transfer via conduction or convection.
To perform properly, radiant barriers need to face open space (e.g., air or vacuum) through which there would otherwise be radiation.
So, the heat is up there and will radiate. The same heat can also be moved down to the ice pad through air circulation. If there is no surplus heat to radiate, there will be no heat radiation. The reason why there is surplus heat in the roof space is because the roof is not insulated and most of this heat is escaping to the outside, requiring yet more heat to be introduced. Therefore, if the roof is fully insulated to the same degree as the walls, the heat will not escape and can therefore be carefully controlled, along with the air circulation, and an optimum can be established that will provide 7ºC at 1.5m above the ice surface. In this case a false ceiling will be unnecessary.
Tools for the job are essential. Planning the purchase of these is not always as straightforward as it should be, and in order to save a few pounds the wrong thing is bought, which doesn't work so well, and eventually has to be replaced at more expense. It is very important to buy the right tools for cutting and pebbling, for cleaning on a regular basis and to have equipment dedicated to curling ice. The reports on *Cutting Equipment* and *Pebble Can Tests* deal with those in some detail. For monitoring equipment it is best to search the internet, every year new developments appear which not only work better but usually cost less, and our advice is to keep things simple. A very sophisticated infrared laser is what it says, very sophisticated, and if not properly calibrated or used correctly is simply useless – a wire probe in the ice will be easier to use, more accurate and very reliable. For cleaning equipment have a vacuum cleaner ONLY for the ice hall – fetching it from the bar every day takes too long and will result in less vacuuming of those surfaces that matter more. Ice brooms should not be used on other floors and vice versa, while cloths and towels too should be dedicated. If necessary install a cupboard with a lock on it to prevent these tools from growing legs and walking away.

In summary, every aspect of planning requires lengthy and detailed research. Manufacturers supply information, but all too often it is biased in their favour to support their product. Experts are available, but very few experts exist who have sufficient experience of curling ice to be of reliable help. It can be a nightmare, and the only escape is careful study, detailed planning and plain good common sense.

John Minnaar
August 2012

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