## STRATEGY

To create anything requires a strategy. From the tallest skyscraper or the largest town to a work of art or the smallest gadget, none can be created without a clear strategy. The clearer the strategy, the better the result, provided all the inherent rules are carefully followed. If the rules are clearly established, any shortcomings in the result can be traced back to where the rules either failed or were not adhered to, and the lessons can be learnt.
To produce excellent curling ice needs an excellent strategy. Relying on water "to find its own level" is self-delusion, because science says it will not happen. Relying on a perfectly level ice pad to stay that way without meticulous maintenance will not work either. Hoping that refrigeration plant will last another year without careful annual maintenance is a heavenly inspiration that can easily turn into hell. Everything in the manufacture and maintenance of curling ice requires strategy.

Note: The Ice Files are intended as a guide for the installation and maintenance of curling ice in a facility that will provide ice for a full season. The more specialist field of competition ice in an arena will not be taken into account. This file is an overview, or an index, of the overall strategy for curling ice – each item listed here will be expanded in more detail in separate files.

1. Planning

Effective planning is directly linked to the timescale. Planning for tomorrow is one thing, but planning a few years ahead is a totally different thing. The requirements of curling ice are such that everything has an influence, from the building and equipment to the maintenance and daily routines, resulting perhaps in an infinite splitting of hairs. Furthermore, when a technician takes on a facility he will not know its problems, cannot immediately see what happens as a result of his actions, and seldom has sufficient technical knowledge to learn any faster than at a slow, steady pace. But learn he must, or he will never succeed.
The first priority must be to acquire as much information as possible from others who know the building or parts of it, and to record these on file. Then he must systematically add all that he learns from day to day and record these items too. Very soon a wish list will reveal itself that cannot possibly be fulfilled in one season, and the planning must begin. There will be the art of the possible, the probable and sadly the impossible, yet the more problems that can be addressed the fewer they become, and the easier the work of providing quality curling ice.
The most essential consideration is this: curling ice is a product that is sold to customers – no product, no customers, no revenue. The better the product, the more customers, and so the more revenue to spend on improvements. Therefore the most serious problems are those related to the provision of the product, from the floor to the refrigeration plant and other equipment, and to the people who will do the work. As most experienced technicians will already know, by now there is no more money in the kitty and the wish list grows.
Through effective planning it is possible to identify the priorities and research their costs. Once this is on paper, it is possible to present a strong case to the board or funding agency to try and raise the money. It is often the case that the best facilities are run by their owners, or even the players, who seldom have the ability to raise more than a limited amount, while other facilities owned by councils have the funding but are unable to put the equipment to proper use for various reasons. The principles remain the same, without careful planning no facility will be able to raise substantial amounts of money, and no facility will be properly run.
It is essential to refine the list of problems as soon as possible in the season. This will enable the owners/committees to discuss the items during the curling season and return their comments for further thought and planning. It will also mean that funds can be sought earlier during the season and the full planning can be in place by the end of the season. Most jobs in a curling rink can only be done during the closed season, and most committees do not meet in the summer. By the time the facility is closing down, the planning should be completed and in place for the summer.

2. Preparation

The facility has been closed down for the summer, the planning is (or should be) in place, and the ice technicians have taken off for a well-earned holiday. It is not uncommon for the technicians to step across the road and start work on the golfing turf for the summer, which will come to haunt the facility in August when none of the summer work has been done, but a properly run facility will enable work to proceed in the rink well before the installation process must begin.

The work in summer is essentially preparation for the next season. With a sand base the thawing must proceed apace to deal with the unseen permafrost beneath the pipes, while the wet sand will prohibit any work for many weeks. Once the sand has dried it will be possible to use ladders, scaffolding and other equipment even if boards have to be used to prevent damage to the pipes, while with a concrete floor the work can begin quite soon.

The most challenging jobs in summer will be replacement of the pipes and/or the floor, as well as the headers and returns, and serious issues regarding the refrigeration and ventilation equipment. For these careful planning MUST be in place to avoid delays, and it will ultimately pay to only use contractors with an excellent reputation. These are major expenses upon which the life of the facility will depend, and if the work is not done properly the ice technician will not be able to do his part properly.

The lesser jobs within the rink are usually an annual routine. A thorough cleaning of all surfaces that can be cleaned is the first priority, and once this has been completed it will pay to control the movement of traffic into the rink, or the work will simply have to be done again. If there is work to be done that will create dust, this work must be done before the big clean. If the sand is going to be worked level, the big clean will follow that. Any changes to ducting, heating, wiring and such can usually be done quickly with little mess, provided the work has been well planned and controlled. Once they're clean all surfaces in need of paint can be tackled, but because paint or cement will not dry or set below about 10ºC, these items must be completed at least a week before the plant is switched on for the next season.

If the stones are to be refurbished, they should be sent to the manufacturers as soon as possible. The regrinding of the cutting blades too must be done as soon as convenient. The refrigeration plant will need two visits from the engineers, one to remove the gas and shut the plant down for the summer (and note any problems discovered in the process), and the second to fully service the plant, replacing seals and returning the refrigeration gas. The cooling part and heat exchangers will need a good clean as well to ensure maximum efficiency, while the dehumidification plant too will need a thorough service. It is essential that all the plant must be serviced properly to ensure maximum efficiency, because any small deficiencies will cost a great deal of money in electricity or gas to compensate. Inefficient plant is at least twice as expensive to run.

Dealing with the problems of a sand floor can be a thankless task. At the worst end the battens and/or saddles might need replacing, which is a massive job and – in our opinion – a waste of time and money. In order to do this properly it is best to remove the pipes, remove most of the sand and start again from scratch, in which case the better long-term solution must be to install a concrete floor. If this is not feasible, then a laser level or theodolite is essential to ensure that the pipes are level and well supported within a very few millimetres – the more level the pipes are, the more consistent the ice will be. The preparation of a level ice surface starts here, in the floor, under the ice. Once the pipes are level they must be covered with a layer of sand sufficient to allow for loss through seepage and settlement, resulting in a smooth surface about 10mm above the top of the pipes, with the level confirmed by the laser readings over a grid of one metre spacings.

A concrete floor is much easier. The floor will already be clean and dry, and cracks can be dealt with according to their severity. Annual painting of the surface is not always necessary, but of course if it is done well at the outset it will be easily maintained. Bearing in mind that some paints have better thermal conductivity than others, several layers of the wrong paint will cost more in refrigeration, so do it properly from the start and look after the surface when it is not protected by ice. The most cost-effective system is to clean the floor properly, using sugar soap or vinegar in dilution, and then seal the entire floor with diluted PVA. Once dry, paint with a quality matt emulsion – the white can be done with rollers and will usually need at least two coats, while the circles can be done by brush. Remember to allow at least a week for the paint to dry and set, and only walk on the surface in socks or with plastic surgical overshoes to avoid marking the pristine paint.

Cleaning walls, which in many cases will be covered in a near-invisible layer of mould, can be done before removal of the ice, allowing spillages to be removed with the ice. Alternatively sheet the floors of the walkways and/or the ice with plastic to catch the dirty water. Spray the walls with diluted malt vinegar to kill the mould, then wash carefully with a pressure washer to clean the wall properly. If done patiently and systematically, this is surprisingly easy and not messy at all. Once dry the walls can be repainted, and again a good job will save repainting the following year. If the walls are porous, such as concrete blocks, it is important to seal the outside with a sealant of some kind to eliminate migration of moisture – water WILL migrate. A combination of diluted PVA and exterior emulsion will do the job.

It is most important to have a very good plan in place from the outset, with extra time allowed for the unexpected problems that always cause delays. Plan, prepare and be ready when the day arrives to start the plant and chill the floor.

A word of warning is appropriate here. It is often the case that refurbishment of the club room and changing rooms will not be the responsibility of the ice technician and he will not even be informed, yet this work too must be done during summer. Be sure to know whether such work is planned, who will be doing it and how it could affect any of the other work in the rink itself.

3. Building the ice pad

The single objective is to create a perfectly level surface over the entire floor of the curling rink. The exercise must be carefully planned and well prepared, and systematically executed. To understand better what is meant by "perfectly level" please refer to the report on *Level*, which culminates in a definition that requires a single sheet of curling ice to be level across its width of 5m to within 0.05mm, beyond which it is extremely unlikely that a curling stone will be affected in its progression down the sheet of ice. Building the ice pad must achieve this, and can achieve it, over the entire floor of between 1000m² and 2000m².

During the preparation phase a laser level plays a very important role. In the case of a sand floor the laser has been used to control the process and hopefully provide a surface of sand that is level within 5mm throughout. There will be no need to map this, because the sand can move during the flooding process and so change the level, whether by compaction or heaving. For a concrete floor it is important to map the entire floor at 2m stations and transfer the readings to an Excel spreadsheet, from where it is easy enough to produce a surface chart that displays the contours and so the variations in level. Do not be surprised if there are variations of as much as 100mm – 50mm is very common while 5mm can be achieved through modern techniques of laser surfacing. Once a concrete floor has been mapped in this way, readings from subsequent years will also be able to reveal whether the floor has moved through heaving caused by permafrost – if so, the heat mat and/or insulation must have a problem and should be investigated as a matter of urgency.

Sand floors require some experience and skill to be frozen properly. The process starts with spraying the sand until it is consistently moist to below the pipes, and the best way to see this is to dig up a few holes and look. Once moist, drop the floor temperature to around 0ºC and spray again, as evenly as possible. Now lower the temperature to – 5ºC (refrigerant at about – 9ºC), and continue spraying until the floor is solid, yet still porous. Only now can the flooding begin, starting with a reasonably heavy flood that will melt the floor as far as the pipes and then refreeze (about 400 litres per sheet). Once the flood has frozen, allow a few hours before repeating with a similar flood. Progress to heavier floods of 500 litres per sheet until a reasonable level is achieved.

Concrete floors are approached differently. First cool the floor surface down to – 4ºC and apply several light sprays to seal the surface of the paint, allowing sufficient time for each spray to freeze and return to – 4ºC. The laser map will show where the lowest areas are, and these can now be built up with small amounts of water – as a guide the thickness of water each time should not exceed 3mm – until a rough level is achieved. Start the flooding with a few light floods of 200 litres per sheet to ensure the paint is safely covered, then progress to heavier floods of 500 litres per sheet until a reasonable level is achieved.

The thickness of the ice at this stage will vary from rink to rink. In an ideal scenario it could be as little as 10mm, more commonly it will be 20mm or more. By now the surface will be slippery from salts rising to the surface, but as long as all the sand or concrete is below the ice the salts can be removed through multiple pebbling and cutting, using an older blade to avoid ruining a good one. Warm water at 40ºC works best and the drops can be quite small, because the salts will rise into the pebbles and will be easier to cut off. When most of the salts have been removed, add another flood and repeat the process of pebble-cuts until the snow is clean and very white.

For sand floors, and concrete floors that have not been painted, the ice surface can now be sprayed white, using a suitable powder paint. Once consistent and beautifully white, seal the paint in with several light sprays. It helps if the ice surface can be kept as cold as – 4.5ºC throughout the process. Once properly sealed the houses or circles can be added, and also well sprayed in. Follow this with a few light floods of 200 litres per sheet until the surface is level again. After the usual pebble-cutting the lines can be installed and sprayed in, followed again by two light floods, and heavier floods until satisfied. Continue the pebble-cutting between floods to remove as much of the salts as possible.

The finishing floods will be light, but at a warmer temperature to give the water as much time as possible to settle before freezing. This means switching off the plant for about half an hour before flooding, and not switching back on until the flood is complete and has settled, perhaps another fifteen minutes. The pebble-cutting will show just how level the surface is, and by now it will be safe to use a newly-ground blade that is cutting evenly – this is the best time to test new blades, when the ice is at its most level.

The resulting surface is now referred to as the ice pad, which should remain the working surface for the entire season. It is quite normal for technicians to add floods during the season mainly to correct problems in level caused by their own work (or lack of), but if the playing surface is well maintained we have proved that an ice pad can in fact last a full season within the 0.05mm limit of level.

Much has been said and written about the use of deionised water for the provision of curling ice. For most rinks this is a luxury, it costs money but it has its uses. In our experience ordinary tap water or even well water can be used, provided the regime of pebble-cutting is not neglected. See the reports on *Pebble* and *Pebble Salts*.

4. Creating the playing surface

If the ice pad has been built well, this will be easy, but it seldom is. On the one hand there will still be salts in the surface and it will take a week or so to finally be rid of them. Fortunately this can be done during normal work, which means a good cut in the morning followed by normal preparation for a game of curling, and if needed the same in the late afternoon. On the other hand there will also still be irregularities in the surface, sometimes only small areas but often long lines down the surface, where some pipes are lower, higher or less efficient and the ice pad has remained lower than the remainder. They become very obvious during cutting and can be dealt with, but it all takes time.
The best strategy here is to use only clean water for pebbling, usually around 40ºC, and this can be distilled (collected from the outflow of a mechanical dehumidifier), deionised water or water from a reverse-osmosis plant. If only clean water is used, then no more salts will be introduced, and gradually the remaining salts can be removed. Filling in small areas will not usually be necessary, because a week's normal maintenance will fill these quite well. For long lines it will help to pebble with an overlap over the area, using a small pebble, and cutting the sheet after every pebble with a level pattern. After a few pebble-cuts the line will fill in and disappear, usually for good.
Once the ice pad has been created it will be time to return the stones to the ice to cool down. The use of perforated plastic beer mats simplifies this (be nice to the bar staff!) – with the stones not in contact with the pad yet close to the ice they will be cool enough within a few hours to be placed on some pebble without melting the pad with their tell-tale rings. It will take about a day for the stones to be fully chilled.
The hacks too must be fitted to the ice. There is now a tendency to place these in the ice before the finishing floods and flood their bases into the surface, but there are also designs that simply melt into the surface of the ice because they are warmer, and then freeze into place. The centre washers for the houses will be remembered as an afterthought.
The playing surface can only be considered ready when it can provide the requirements as defined by the World Curling Federation for a game of curling. The definition is important for a variety of reasons (see Curling Ice Explained), and all technicians are urged to adopt these and fulfil the requirements.

**For Curl:** *To play an offensive game with many stones in play, the curl with naturally-matured stones (see above) should be 4 foot on a draw – not less and not more. This will allow for draws around a guard stone with adequate distance between the guard and hidden stone. It is possible with good precision to play a "freeze", and even to be able to push a hidden stone.*

**For speed:** *To have the same speed and curl in the beginning of a game as at the end is important, because the teams can begin the offensive play immediately without risking too much. A good draw weight should be 24-25 seconds (hog to tee) all over the sheet from the first end to the last on both the in-turn and out-turn. There should also be good "living" in the stone, which means that the stone shouldn't slow down too fast at the end of the movement and should be easy to sweep.*

Although the behaviour of the stones are influenced by several factors, mainly the pebble, control of the parameters and the running bands of the stones, the level and consistency of the playing surface is by far the most important. Create an excellent playing surface and the rest becomes much easier.

5. Maintaining the playing surface

Although it is always frustrating to see players damage the ice simply by using it for their games, this is inevitable. The playing surface has to be maintained and restored to its best, after every game and before the next game, and usually there isn't always the time. This is the job, provide the product for which the customer pays, no matter what the damage might be. The interesting point to remember is that the ice technician, simply through his work, can do more damage to a playing surface than all the curlers put together.
It is essential to build a very good ice pad, level to the extreme, because that can be maintained. Having achieved such a thing, what is the point in messing it all up with poor maintenance, incorrect techniques, dodgy equipment and plain neglect? The expanded file on this subject will deal with every aspect in detail, while here only the simple basics will be addressed.
**Pebbling** is a very fine skill when done properly. With the right equipment and technique it is perfectly possible to distribute drops of water in such a way as to cover the entire rink in the same way, with about one drop per cm² and all drops much the same height above the ice pad. This can be improved by shaving the tops of the pebbles with a Nipper, and so remove the tops of all the higher pebbles, resulting in a silky smooth surface that is wonderful for a good game of curling from start to finish.

 

The use of clean water at the right temperature has been proved to strengthen the pebble and enable it to withstand the attacks from stones, brushes, pads and shoes for ten ends of curling. Many other factors come into the equation here too, but as a simple rule the water must be clean and at 40ºC in the can. The speed of pebbling that works for most is eighty to-and-fro swings of the arm in forty seconds between the backlines, applied twice in opposite directions, and aiming to overlap the sidelines by about 20cm. The SCIG seldom use a pebble larger than fine or extra-fine. See the report on *Pebble*.

The quality of the distribution of pebble cannot be emphasised too strongly. An unbalanced pebble is the easiest way to ruin all the hard work that has gone before. Even a very small variance will quickly accumulate with successive pebbles, until only flooding can restore some kind of level. It is for this reason that the pebble must be removed regularly and efficiently, to prevent the irregularities from accumulating and becoming a problem.

**Cutting** is the means by which the pebble is removed. Because it is so difficult to see whether an ice pad is actually level or not many misconceptions exist, and everyone suddenly develops a technique "that works". Having studied the essentials for many years, later with the help of the IcePOD, we developed a technique that is not only simple, but it does actually work and we can prove it – because of the IcePOD. This is an instrument that we had made at great expense that stretches a thin cable across the width of a sheet of ice, so tightly that it does not sag, enabling us to read the level of the ice surface to within 0.01mm. The IcePOD, if used correctly, has built-in safeguards so that it cannot lie – if the IcePOD says it is level, then it is level, usually within the margin of 0.05mm.

The cutting patterns we developed can be found in the report on *Cutting Technique*. This file has been downloaded by hundreds of technicians and, to the best of our knowledge, are in use all over the world without problem. Combined with even pebbling as above, these can keep an ice pad level for an entire season without flooding.

An overview of the equipment can be found in the report on Cutting Equipment. A simple summary requires a good machine, preferably powered with batteries, a sharp and true blade at the correct slant, and the equipment needed to clean up afterwards. It pays to invest in the right equipment, because it will be in use every day and there will be no time for instant repairs. The right broom, shovel and bin will work well without problems, but the wrong stuff will create more work and cost extra time and effort.

Even under ideal circumstances it will take at least seven minutes to resurface a single sheet. The daily morning cut, along with all the cleaning jobs and finishing, will take about twenty minutes per sheet. It is obvious that cutting between games will be impossible unless sufficient time has been fitted into the booking schedule, usually allowing for a quick resurface in the afternoon, ahead of the evening games. It is advisable to cut after four layers of pebble, the first a double and the others a single, which will provide good ice for three games at most. If these pebbles are not removed, it becomes very difficult to return to the pad every day, and the pad will gradually lose its level. It is also very difficult to remove large pebbles with a few quick passes, because there is simply too much ice for the blade and batteries to cope with – more ice, more resistance. We use fine or extra-fine pebbles not only because they work well, but because they are easily removed as well, and we generally manage to cut after only three pebbles or two games. It pays, it works, it's really very easy if it is done right.

**Controlling the parameters** will begin as soon as the plant is switched on for the season, with settings adopted from what was learnt during the previous season. However, without accurate measuring equipment and probes in the right places, the job will be very difficult.

The first essential will be a probe somewhere in the floor, usually above the insulation and below the ice pad. This probe will tell the controller of the refrigeration plant what the temperature is, allowing the controller to switch the plant on and off. The next essential will be a probe somewhere in the roof space that controls the heating supply. There will also have to be a hygrometer in the air space to control the dehumidifier(s). Without these three the system will simply not work so well, if at all.

In addition it will be extremely helpful to be able to tell the IST (ice surface temperature) accurately within 0.1ºC. A handheld infrared thermometer is the simplest, but unless it has been properly calibrated and acclimatised the readings can vary from unit to unit by several degrees. A more accurate system is a wire probe embedded in the ice just below the surface, connected to a simple display unit which can be as far away as the cable is long – once the probe settles down it will be extremely accurate and less influenced by air movement.

Another very useful extra is a series of wireless thermohygrometers that will transmit both temperature and relative humidity to a base unit. If the probes are at 1.5m, 3m and 4.5m above the ice surface, the effects of heat versus cold can be tracked in the air space and so allow for fine adjustments that can save a good deal of money. As this is indeed a battle between hot and cold, too much heat will require more refrigeration, while too little heat will make for very cold curling. It has become standard to read both AT (air temperature) and RH (relative humidity) at 1.5m above the ice surface, and the general consensus is an AT of 7ºC and an RH of 55%. If the IST can be maintained between – 3.5ºC and – 4.0ºC the optimum has been established.

6. Removing the ice pad

The day will finally come when the season is over, the stones can be moved to storage and the plant can be switched off. Within a few hours the ice surface will begin to melt and a thin layer of water will gradually cover the entire floor. If the ice has been painted, now is the time to remove the paint before it reaches the floor, whether sand or concrete. This will require some refrigeration to ensure that the ice remains fixed to the floor and gradually melts from the top downwards, and once the paint layer is thawed it can be pushed towards the drain or a corner to be collected and properly disposed of.
If the floor has been painted, it is as easy to leave the plant off and let the ice thaw in its own time. Within a day or two the ice in some areas will already be floating on a thin layer of water, but it is better to wait until all of it is loose before trying to move it. Some technicians like to attack this lot with a front-loading machine and scoop the ice up quickly, and so commit themselves to painting the floor again to hide the damage they've done. A more gentle approach is to push the ice into the drain or corner using large brooms, where it can melt in its own time. Once the ice and water has been pushed away, it is essential to wash the floor before it dries, otherwise the dirt of a season's curling will do its best to glue itself to the paint and be quite impossible to remove. A hose spray and soft brooms will do a good job that doesn't take very long at all.
At this stage it is essential that the planning for the summer work has been done and a strategy is in place that will allow essential work to proceed on schedule. Once the curlers abandon the season and return to their golf it will be too late for meetings and things will quickly start going wrong.

7. Closing down

A sand floor will take some months to fully thaw and dry out, and using the heating system to help the process will cost money. The simplest is to open doors wherever possible and allow the summer heat to enter the building every day. If the floor is not fully thawed, the frost heave will get a head start for the next season and could ultimately destroy the building. The amount of drying is less critical and will depend on the kind of work to be done.
A concrete floor will need to be properly washed and kept clean for the summer. This is not difficult, but if the building is to be used for other things during summer it will pay to cover the surface with boards and carpeting, and this must not be done while the surface is wet or even damp. In our experience it is best to dedicate the facility to curling and have no such activities, they seldom generate the revenue to justify the extra work and cost.
It is very important to have the plant properly shut down by a competent refrigeration engineer, who will usually also remove the refrigeration gas from the system. This gas is expensive, and as the plant warms up the seals will move or crack and the gas will be gone. It also pays to give the whole place a good clean once all the water is gone and leave it ready for the next season, noting all repairs that need attention and adding these to the summer schedule.
The strategy has now come full circle, the year is over and the next year can begin.

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