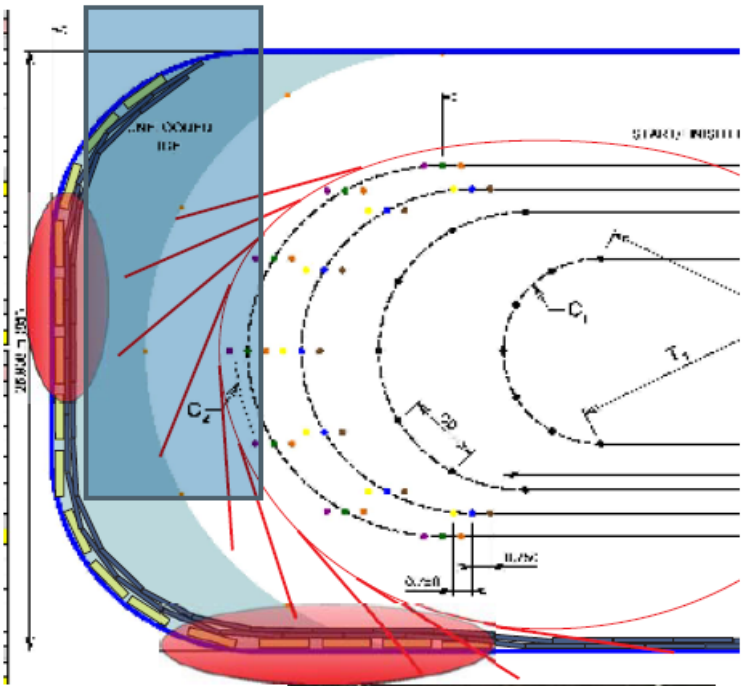
Additional Protection - Protective mats in front of the boards

Introduction

The Safety Committee of the Quebec Speed Skating Federation is pleased to propose a new initiative in terms of protection. In this document, you will find the basic technical elements explaining this initiative. The way to position the protective mats in front of the boards is also presented.

Technical details

This is a system that has the potential to greatly improve the performance in terms of protection against the boards in short track speed skating. The experience in competition has shown that the zones highligthed in red are the critical zones in terms of risk of injury. On the drawing, the red lines are all of equal length. Visualising the distances and the impact angle on the boards, we can easily recognize the critical zones.



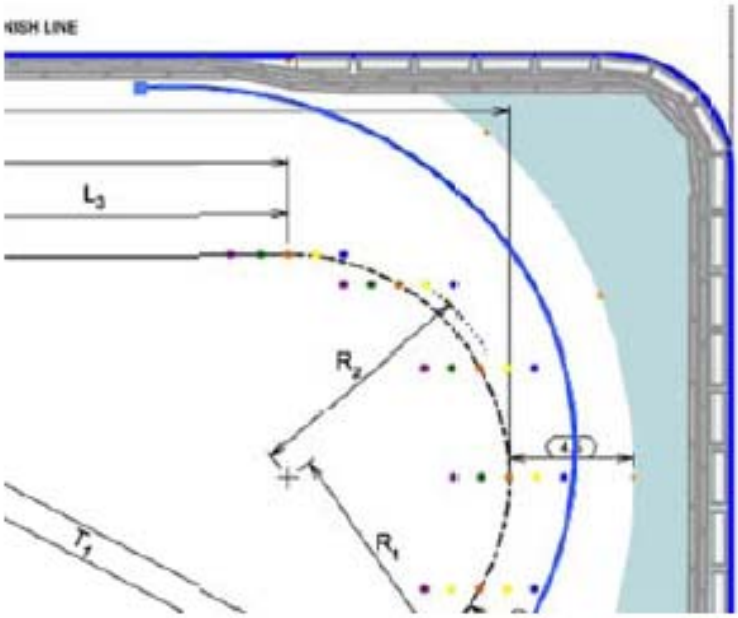
Because the clubs are already equipped with mats, the idea is to improve the present situation by increasing the distance and the shock absorbtion time while reducing the rebound effect following the impact with the addition of a half-height mat.

In order to do so, the shock absorbtion distance must increase by bringing the mats forward. This way, when there is an impact, the energy necessary to compress the mats in the boards allows a more constant rate of deceleration, which is an efficient way to protect the skater. The shock absorbers, which are the half-height mats placed right against the boards, must be soft to allow them to flatten at the time of impact. In the case of high speed impacts, the mats flatten and move a lot. We

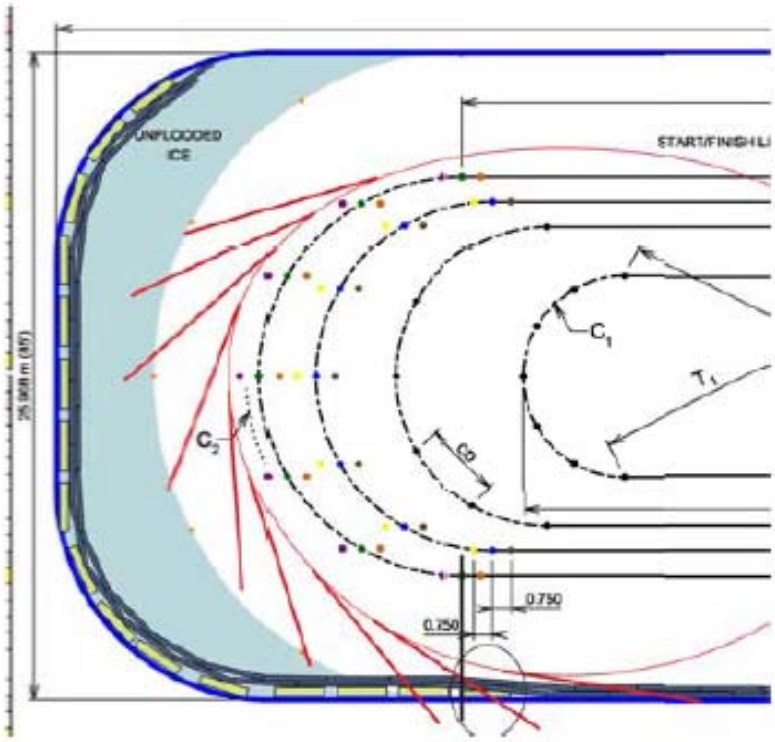
must use the velcros on both rows of mats. In addition, if they are well attached together, the mat that receives the impact pulls on the mats on each side and uses this energy to absorb the shock of the impact.

The mats in front (closer to the skaters), which are more firm than the sock absorbers, are used to increase the contact surface on the shock absorber. This way, the impact surface is made larger and this decreases the pressure applied on the shock absorber. This first concept allows the system to be effective even if the skater does not assume an ideal position while hitting the mats. In addition, because the pressure is lower on the shock absorber and because it is relatively soft, it allows it to be effective at almost all speeds regardless if the skater is light or heavy. Finally, it reduces greatly the rebound effect, a very important point to avoid injury inflicted by other skaters passing behind.

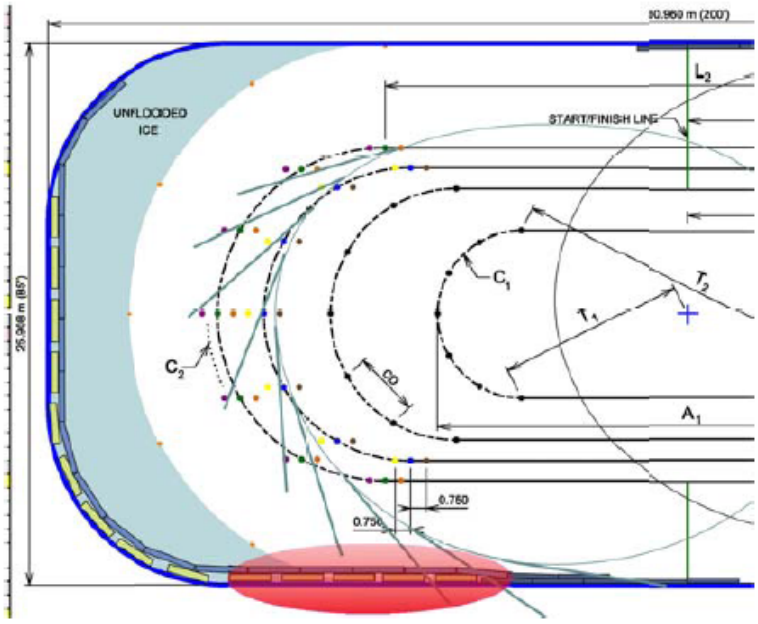
In order to avoid obsturcting at the end of the turn, especially on the rinks that are not of international dimensions, the first shock absorber is placed in line with the 7th block on the middle track. This position allows to avoid obstructing at the end of the turn.



On the other hand, if you desire to optimise the protection at the exit of the turn, you can add an extra shock absorber. Three rows of mats or if you have thinner shock absorbers, could be used to offer a smoother transition at the exit.

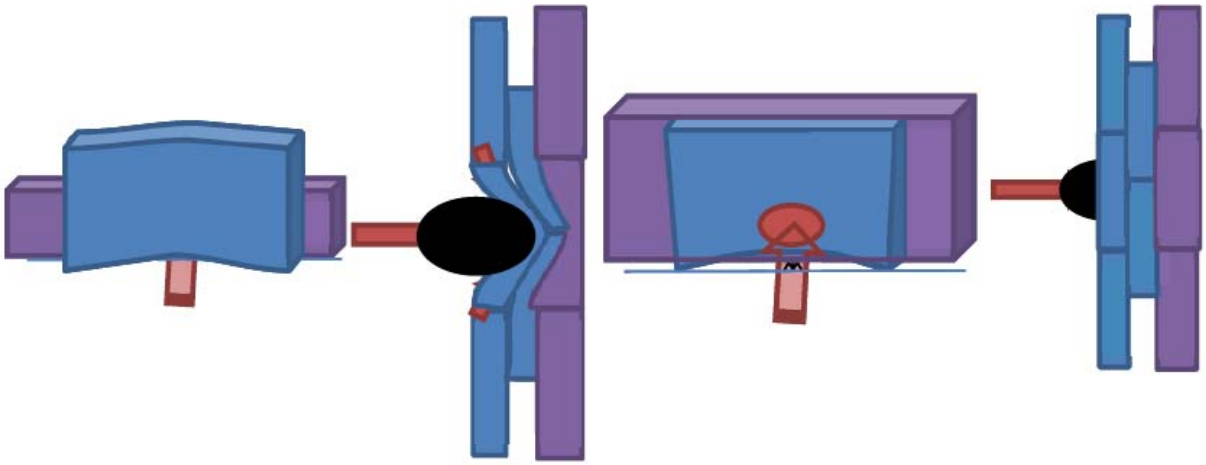


It is also important for those who skate the 100m track to visualise that the critical zone for injuries is brought forward in the straight away. We must cover up until the center and place the first shock absorber in line with the last dot of the 85m.



The shock absorbers can be spaced with a 45 cm gap in between, except in the case where we only use one mat of 20 cm in front of the shock absorbers. Among the possible options, there are: 61cm x 35cm x 195 cm (2’ x 14 po x 6.5’) that seems to work well. They can also be slightly thicker, or longer

or shorter. The height should ideally be 61cm (2') because skaters sometimes fall in a sitting position and we want to avoid having the mats pivoting backwards in case they would be shorter than 2'. If the shock absorber is higher than 61cm (2'), the mat could pivot forward following an impact (...) creating a space below the mats as high as 15 cm (6po).



Here is the possible layout with spacing of the shock absorbers (in red). Note that we have to cover the joints in the mats, so avoid having a space in line with a joint.

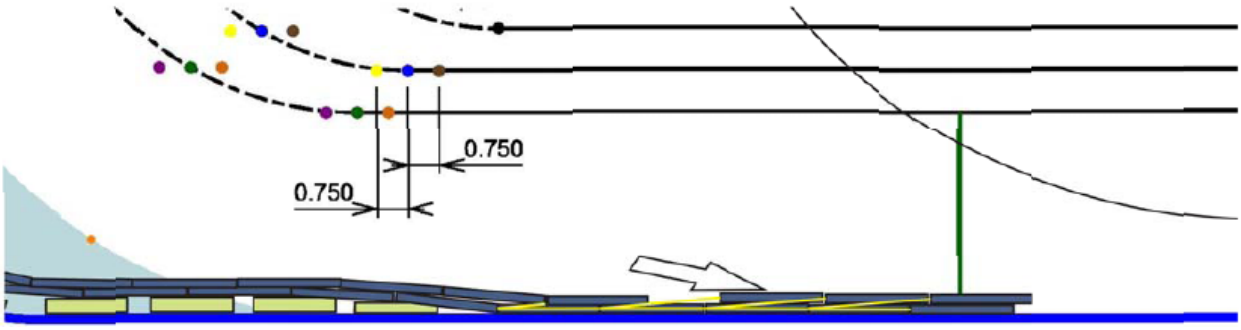
If you already have short mats, they can be cut to make them softer.

Cut triangles with a bread knife (view from top).

Also, because they will flatten a lot at the time of impact, the covers should be ventilated.

For the exit of the turn: #

It is interesting to consider the movement of the first layer of mats that the skater will displace while crashing at an angle, in view of avoiding rotation, concussion and to use friction between the mats for shock absorbtion. Ideally, we should use elastics to avoid mats to fall on the ice after an impact and allow a lateral movement. In addition, elastics will put mats back into their proper place automatically for the next lap. Because the skater arrives at an angle, the force of direct impact is 50% lesser and therefore a mat of 20 cm works well but we must double the mats in order to avoid bareing the boards after a crash in the event a second skater falls. Evidently it is very important to firmly attach the first layer of mats to the boards in order to insure that it stays in place to protect the second skater who could fall at the same spot as the first one. Therefore, we must install velcros on the mats that are against the boards, a thing that is not always the current practice. For the first layer of mats, special attention should be paid to attach the mats together using velcros where we find the shock absorbers. However, where we make use of elastics between the blue line of hockey and the red line, velcros can be secured more lightly in the front to allow separation of the mats at the time of impact at an angle and avoid blades to slide under the mats.



Here are some physics explanations of the system with shock absorbers:

A principle that must be explained is that the energy that the mat must absorb is kinetic energy = 1/2 (mass x speed square). The most determining factor is speed since it is square in the equation. The weight (mass) of the skater is also taken into account in the formula, therefore for a similar speed, a lighter skater will generate less kinetic energy.

Another principle is that the foam has an absorbtion capacity that is function of their density; the denser the foam, the larger quantity of energy it an absorb. A dense mat is ideal for a heavy and fast skater. But here is the problem: because skaters don’t have the same weight and speed at the time of impact, it becomes impossible to make the ideal mat. The main problem is that we must have an important distance of penetration in order to avoid injuries. If the mats are soft, they will not absorb a lot of energy, the fast and heavy skater will crash into them without losing speed and finally, it is the boards behind that will stop the skater. However, if the skater is light and slower, it will sink into the mats with an adequate distance to avoid injury without being stopped by the boards, therefore, the

soft mat would be ideal in this case. But if we select a mat that is ideal for the heavy and fast skater, the firm mat, the light skater will not sufficiently sink into the mat, he or she will likely suffer injuries even though the mat would be ideal for the heavy and fast skater. It is to address this problem that we must improve the protection system as a whole with a combination of mats and shock absorbers.

To give a good idea, considering the absorbtion as a constant for the sake of comparison, a thing that is not true in reality since absorbtion is never constant, we can make the following exercise:

A skater who skates 9.3 a lap, we can calcualte the G force at the impact in terms of distance that he or she sinks into the mats. The G force represents the number of times the weight of the skater (g= gravitational acceleration=9.8m/s square). Here is the computation:

- 2x20cm plus 35 cm shock absorbers (75 cm in total), if he/she sinks by 54cm = 15g
- 2x20cm (40 cm in total), if he /she sinks by 29 cm = 27g
- 30 cm, if he/she sinks by 22 cm = 36g
- 30+20+20 firm (70 in total) if he/she sinks by 22 cm = 36g
- 20 cm if he/she sink by 16cm=50g

This example illustrates well the advantge of a higher distance of absorbtion. A 50g, it’s an injury of some sort guaranteed. Above 20g, it is still insufficient in terms of protection.

For the most advanced levels of skaters (elite and higher (8,5 per lap)), the results of the tests made in dynamics with a weight of 33kg and s surface contact of 314cm square, and a height of drop of 4,75 m, gives the following results:

1x20cm+shock absorber of 35cm = 21g (confirgation not recommended)
2x20cm + shock absorber of 35 cm = 16g (configuration recommended)
1x30 cm + shock absorber of 35cm = 16g (configuration acceptable)

No other configurations without shock absorbers are recommended for the most advanced levels (elite and higher) because we have:

1x20 cm = 80g
2x20cm = 30g
1x30cm+1x20cm=26g
2x30cm=24g
1x30cm+2x20cm=21g

For the results of the tests made at a drop height of 3m, which represents the development level (11sec per lap), the results are as follows:

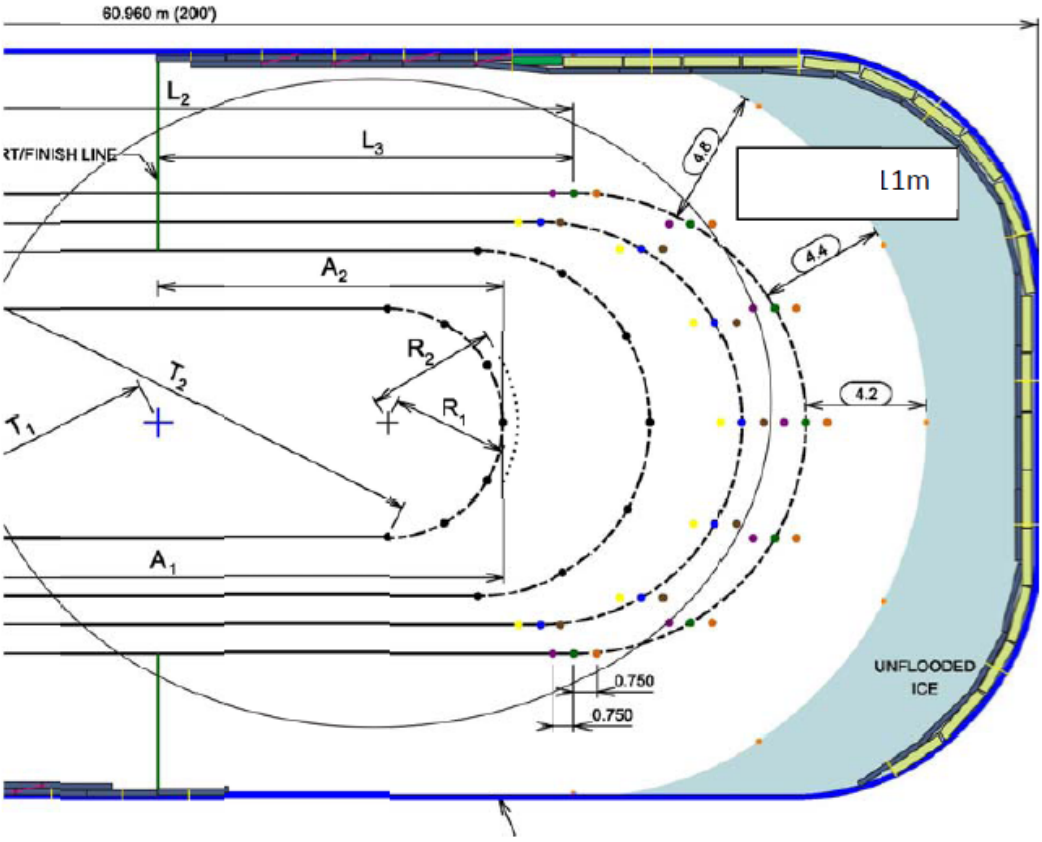
2x20cm=21g (not recommended)
1x30cm+1x20cm=18g (recommended)
2x30cm= 16.5g (acceptable)
1x20cm + shock absorber of 35cm = 15g (acceptable if well tied together)
1x30cm + shock absorber of 35cm = 13g (acceptable if well tied together)

2x20cm + shock absorber = 12 g (recommended)

In the case where a single row of 20 cm mats is used with shock absorbers, there must be no space between the shock absorbers et the row of mats must be well tied together in order to avoid mats to separate after an impact.

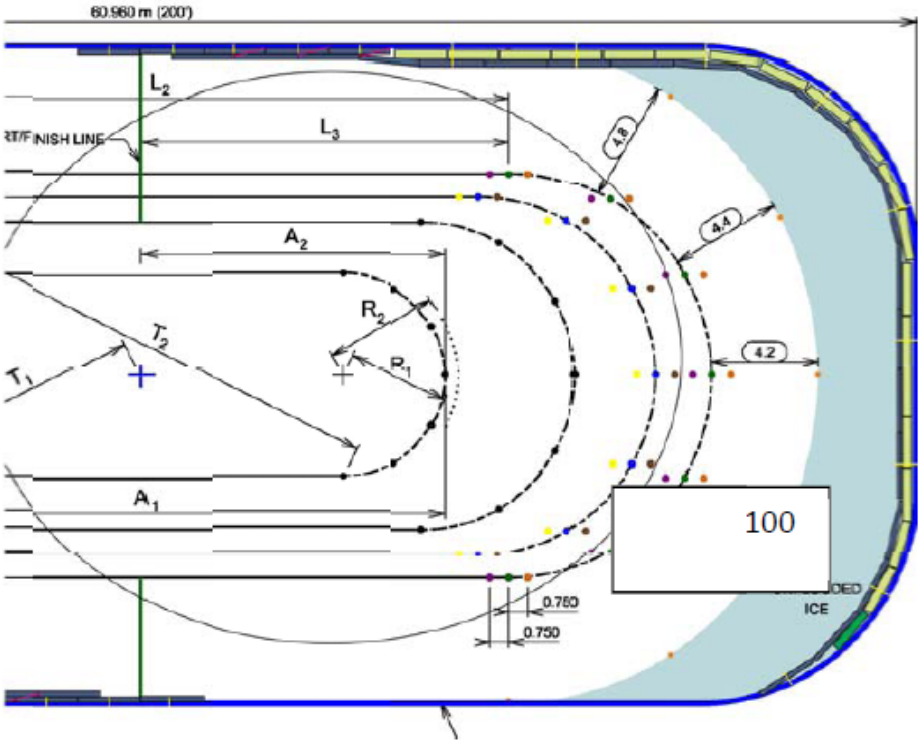
Club version NHL size rink with 20cm or 25cm and shock absorbers until development level on 111m and 100m. (38 shock absorbers of 35cm + 2 thinner shock absorbers + 52 20cm mats or 25cm mats)

Note that the shock absorbers are next to each other because there it only one layer of 20 cm mats in front of the shock absorbers.



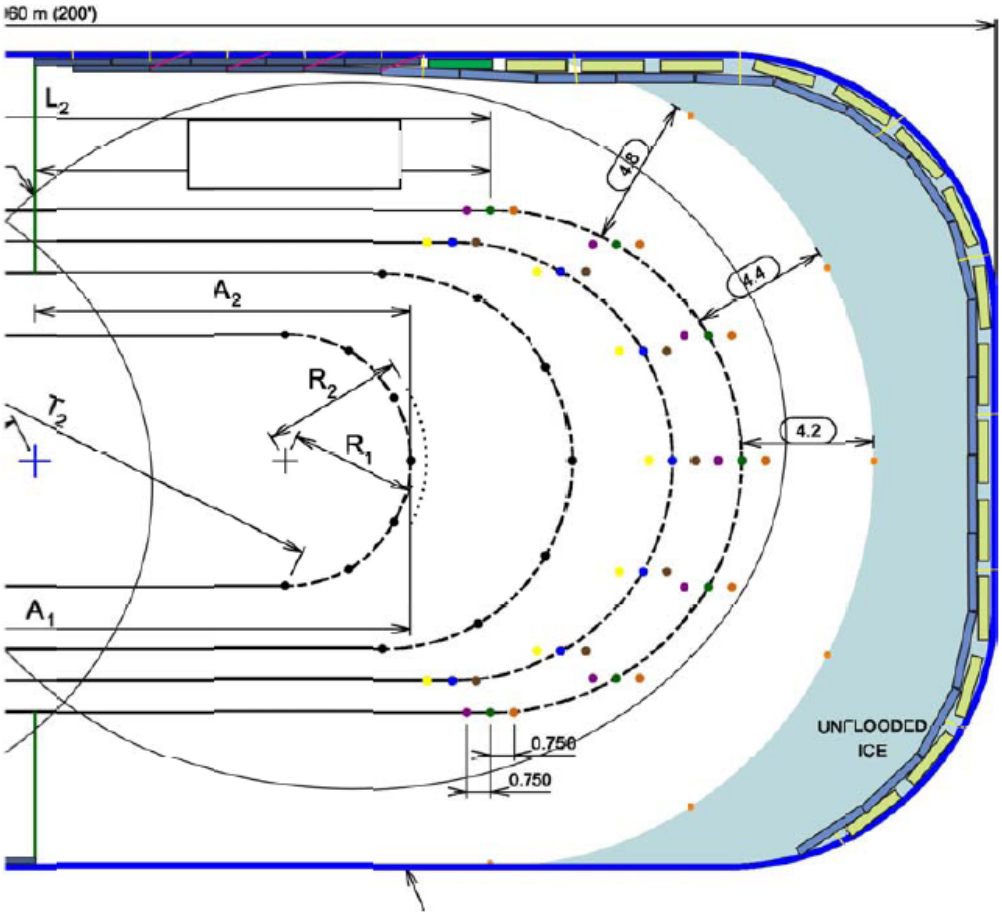
They must be well tied together with velcros ideally on both sides and with some ties that reach to the boards every 2 mats, especially in the corner until the exit of the turn to avoid the mat falling on the ice following a crash and interferes with the following skaters. Using the elastic system for the last 20 cm mats to allow separation of the mats following an impact and avoid rotations at the exit of the turn.

Another important note, the shock absorbers are aligned with the 85m dot on the 100m track and the mats exceed the center at the red hockey line.



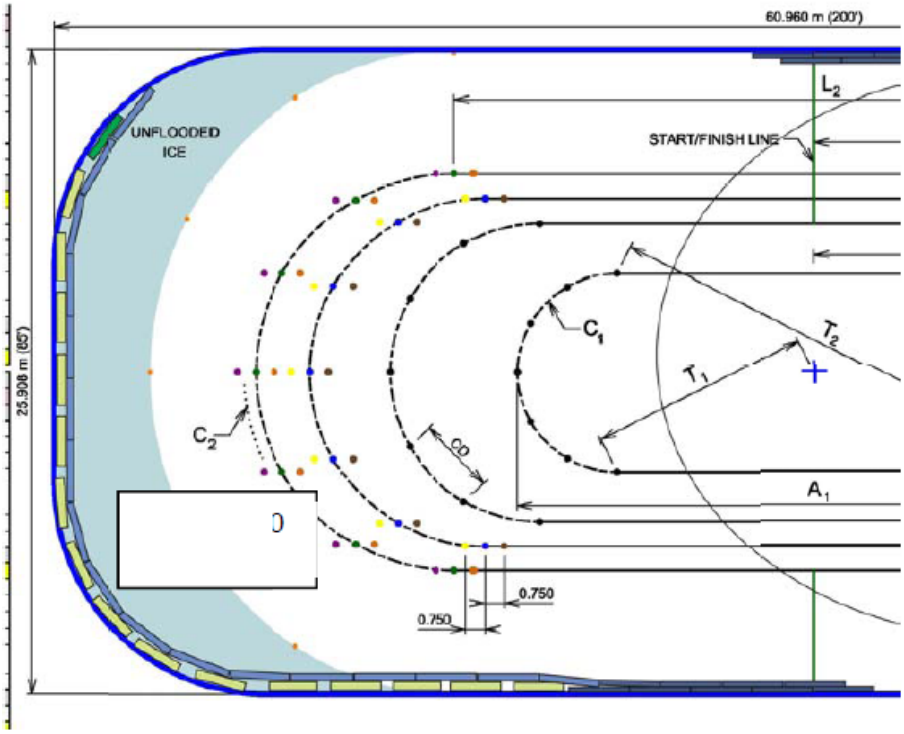
Club version with 20cm mats at the exit and 30cm mats with shock absorbers unitl Espoir Level 100m and Elite Level 111m (30 shock abosrbers of 35cm + 2 thinner shock absorbers of 25cm + 34 mats of 30 cm + 18 mats of 20 cm)

Note that because there is a max of 45 cm space between the shock absorbers, they must cover the joint between the mats and we should not end up with joints in the spaces.



Because there is only one row of mats in front of the shock absorbers, the mats must be well tied together with velcro, ideally on both sides, and must be tied to the boards using ties every 2 mats , especially in the corner at the exit of the turn, in order to avoid that mats fall on the ice following an impact and interferes with skaters who are following. Use elastics for the 4 last mats of 20 cm in order to allow separation of the mats following an impact and avoid rotations at the end of the turn.

Another important point, the shock abosorbers are aligned with the 85m dot on the 100m track and the mats exced the center at the red hockey line.



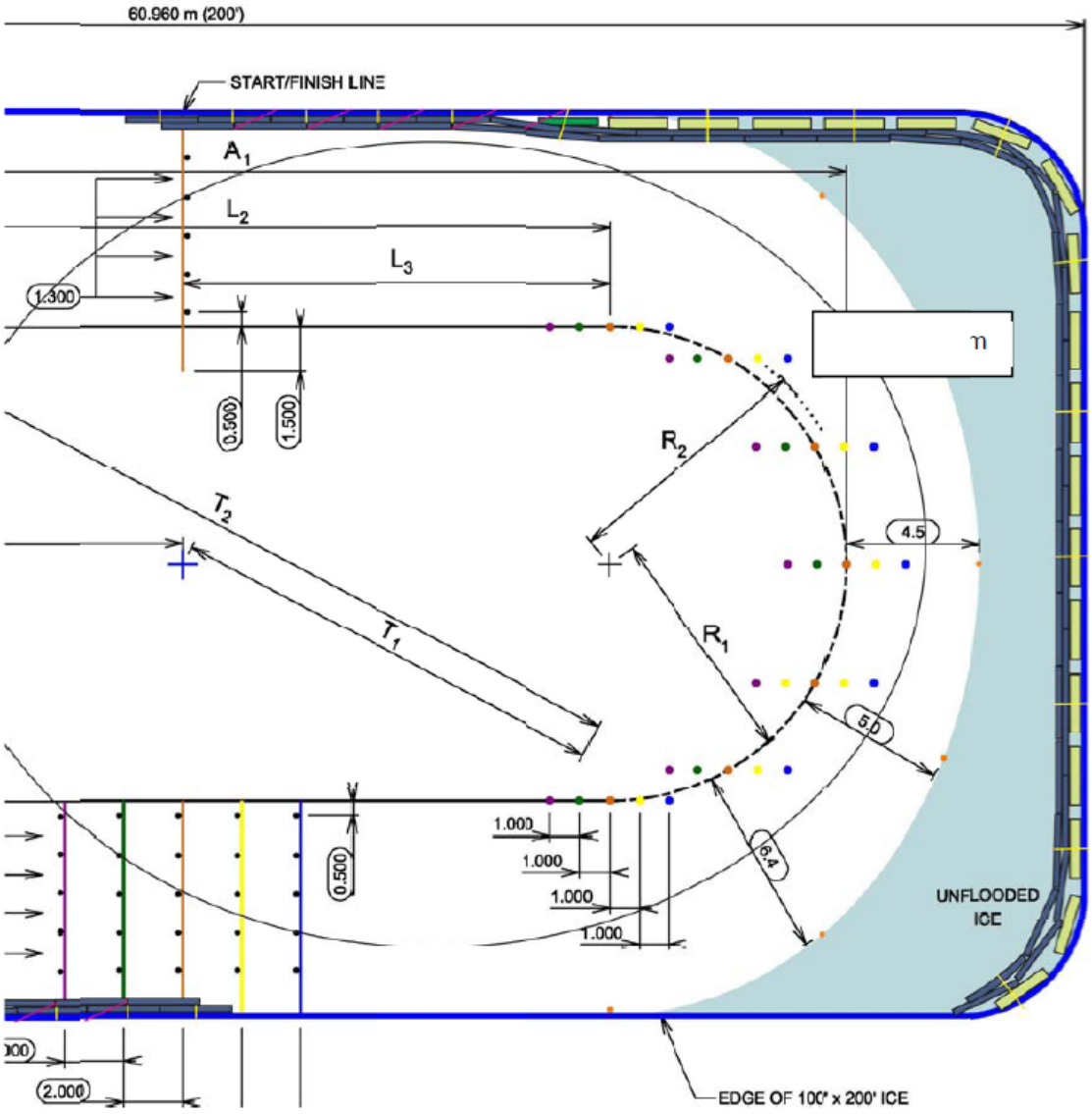
On an international rink

Center version with 20cm mats and shock abosorbers until national level on a 111m track

(36 shock absorbers of 35cm + 2 thinner shock absorbers of 25cm + 98 20cm mats)

Because there is a maximum 45cm space between the shock abosrbers, they must cover the joints between the mats, we should not see joints in the spaces.

The mats must be well tied together using velcros on both rows of mats. In addition, use some ties to avoid the mats from falling on the ice following an impact and interfering with the skaters following. Use elastics for the last 5 20cm mats to allow separation of the mats at the time of impact and avoid rotations at the end of a turn.



On an international rink

Center version with 20cm mats and shock absorbers until international level on a 111m track

(36 shock absorbers of 35cm + 2 thinner shock absorbers of 25cm + 118 20cm mats)

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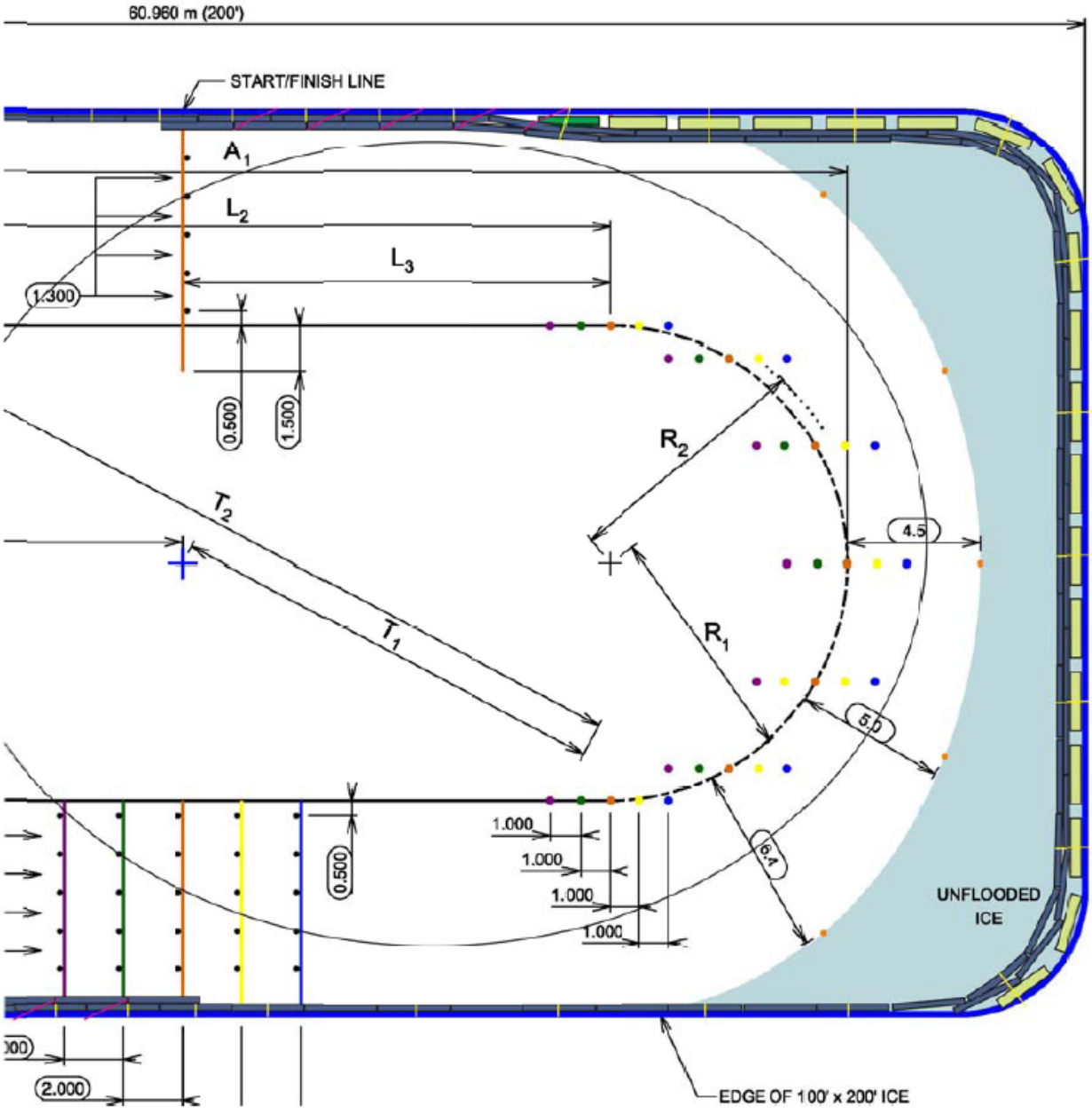
60.960 m (200')
START/FINISH LINE
A1
L2
L3
1.300
0.500
1.500
R2
T2
T1
R1
4.5
5.0
6.4
0.500
1.000
1.000
1.000
1.000
UNFLOODED
ICE
2.000
EDGE OF 100' x 200' ICE