FIS cross-country course and venue design guidelines

Edition spring 2023

1. Introduction

This manual contains useful resources for cross-country course designers, organisers of FIS competitions and FIS Officials. The FIS International Competition Rules (ICR) lists the requirements for homologated FIS cross-country courses, these guidelines provide recommendations for how to meet the requirements in the best possible way.

The goal is to provide a resource for those who are involved in developing courses and stadiums that meet the best traditions in cross-country skiing, are suited for all competition formats and techniques, and provide safe conditions and fair chances for all competitors.

This guideline represents the collective experiences of course designers, organisers and homologation inspectors going back to the venue development for the Nordic World Ski Championships in Oberstdorf 1987 and will continue to evolve on an ongoing basis based on the experience of the users and new developments in cross-country sport.

2. Aspects and philosophy of Competition Course Design

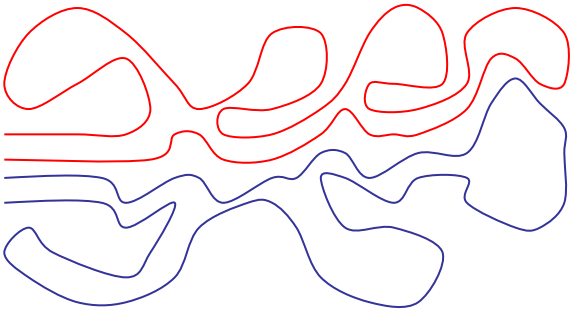
Preserving Cross Country Heritage

In the beginning of the ski history the trails used for cross country skiing were the same trails as used for transportation in the summertime, with limited grooming and no mechanical influence. Cross Country skiing was the means of transportation in the wintertime. The layouts of the first competition courses were made in the same way: *"The best possible trails given the possibilities of the natural terrain"*. Some competitions were also conducted on trails used daily for travel. With the increased use of heavy equipment used in today's trail construction there is a considerable risk that we will lose the "feeling for the natural terrain" that is in the soul of the cross-country skier. Even though we are designing courses for competition, it is extremely important that we take every opportunity to preserve the athlete's contact with the natural undulations of the terrain. This implies that course designers and inspectors have a responsibility to minimize the need to modify the terrain with machinery, but instead must find ways of using the natural terrain whenever possible. The joy of skiing should be the ultimate goal.

Environmental Aspects

Society expects cross-country skiers to be close to nature. We therefore have an inherent responsibility to protect the natural resources. In order to preserve the relationship with nature, course designers must be aware of environmental factors and set a positive example. This includes the need to work with a variety of environmental organizations and landscape architects. The following lists some key areas of concern:

- Avoiding excessive side cuts
- Managing water flow and drainage
- Employing materials that blend into the natural surroundings
- Investigating rehabilitation/reforestation of the site, pre- and post-event
- Focusing on preservation of the snow (using north-facing slopes as much as possible, etc.) and optimising the conditions for artificial snow production



This is a principal layout of a course system that can accommodate all competition formats. It consists of two separate courses, one for each technique in the skiathlon competition and each 5 km long. Cut-offs can make courses of 2.5, 3.3 and 3-75 km length. Also sprint courses can be laid out inside this system. These two courses can be considered as one 10 km course. Another option is a transition from the red to the blue course outside the stadium in order to make a 7.5 km loop that is more suitable for interval start formats.

If the environmental restrictions of the terrain are such that very limited construction is possible, the courses could be designed with minimum width and be homologated for interval start competitions only.

Legal Aspects

It is the responsibility of the organizer or venue owner to perform the necessary research into any legal aspects that affect the proposed site selection and its development, for example:

- Land ownership
- Government authority regulations
- Environmental regulations

Course safety

The safety of the athletes under all conditions has to be considered when the technical elements of the course are designed. Where necessary, permanent and protective fences should be included in the design. Such fences must be constructed in a way that they themselves do not cause safety hazards or obstruct the view of the competition and must be erected with smooth surfaces and without sharp corners that can injure the skier if hit.

Separate spectators' and officials' access to and along the course must be considered, such that the competitors and the courses are not disturbed during the competition.

Course construction standard

The courses have to be constructed to a quality that allows for grooming and skiing in wintertime with a minimum of snow. This means that rocks, tree-stumps and trees on the course surface and in the skiers "fall-line" must be removed, that proper drainage ditches and pipes are constructed, and that a soft or smooth summer surface is planned.

Visibility

One challenge faced in course and venue design is maintain traditional heritage while also creating opportunities to display the sport of Cross-country skiing as modern events that attract in person spectators as well as a broadcast audience. This means creating stadium and course layouts where major parts of the course are visible for spectators and accessible for video production.

Venue planning should include consideration for the ability of the video production to capture the full range of competition tactics in all competition formats, as well as the natural beauty and/or the historical or human significance of the location.

Planning details should include spectator locations and access routes, location of camera positions, cable pathways, equipment load-in routes, and staging areas for production.

Important video production considerations are:

- The more compact the whole course system is, the better for video production.
- The courses for free and classic technique in Skiathlon or Relay should use the same paths as much as possible

- Wherever possible, especially in uphill sections, there should be an extra two meters width for a camera snowmobile, or a separate path close to the course for the snowmobile.
- Occasional trees or bushes between the camera and the athletes is good and gives a better sense of the speed
- Long, straight parts are not desirable. A bit of variation with slight turns and ups and downs are better. This applies for uphill, downhills and undulating parts
- The courses should all have the same approach to the stadium
- The stadium should have one common entry and exit for all competition formats, and provide maximum visibility for the skiers before the finish

Coaching and Feeding Zones

Locations for coaching and feeding stations should be incorporated into course design. These are 10 to 30 m long sections of the course with an additional 3 to 6 m of width to accommodate groups of coaches. Feeding locations are best located within undulating terrain, and on a straight section followed by a slight downhill. Optimally, feeding zones include extra space on both sides of the course. Coaching zones should be located on major uphills and following course segments such as sharp corners or downhills where competitors might break their equipment.

Touristic courses

A broad group of users should be considered when designing venues. Whenever possible, courses and facilities for children and tourists should be included in the design. Competition courses can be modified by creating cut offs to reduce the amount of climbing and technical downhills. Locating skii play areas and tourist trails adjacent to the competitions stadium will allow for universal use of the venue.

Para Competition Integration

To be done.

3. Competition Course General Design Criteria

Requirements

The specific requirements for cross country courses are defined in the cross-country International Competition Rules. In general, the competition course and stadium must:

- Test the skier in a technical, tactical and physical manner
- Provide a degree of difficulty that matches the level of competition
- Be laid out as naturally as possible using the terrain in a balanced manner
- Avoid wind exposed areas
- Be laid out in such a way that impact on nature and the environment is minimized
- Provide reasonable transitions between the varying techniques of the skier
- Remain safe in marginal snow or icy conditions
- Have a distribution of the terrain of approximately 1/3 uphills, 1/3 downhills and 1/3 undulating terrain
- Include space in and adjacent to the stadium for start/finish zones, mix zone, team preparation area, warm-up and ski testing

Classification of Terrain

Basic terrain classification definitions are included in the cross-country International Competition Rules. The following are some further elaborations of these principles.

Partial Total Climb (PTC)

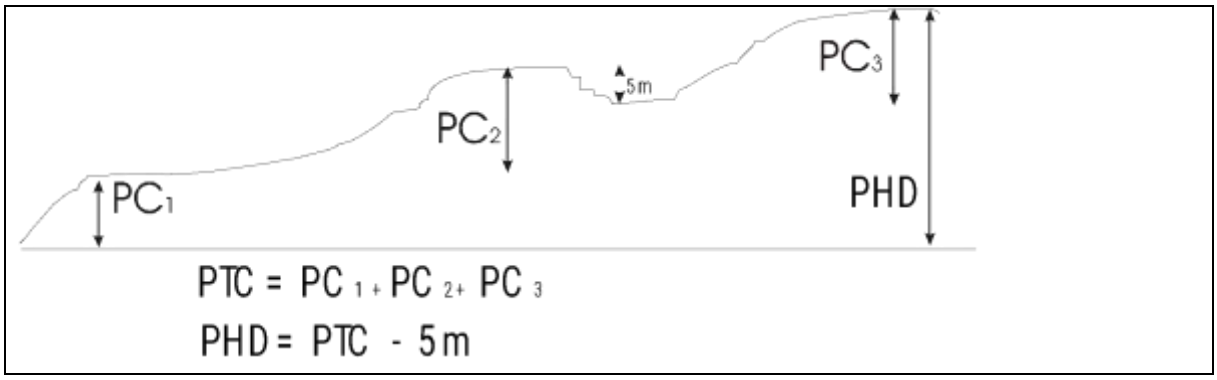
PTC (Partial Total Climb) is the sum of all partial climb segments of a climb that make up an A or B climb that has some varied gradients or short downhill breaks (see figure below where PTC = PC1 + PC2 + PC3).

If an A or B uphill has no downhill parts then the PTC = PHD.

PTC is used to calculate the Maximum Climb and Total Climb.

Partial Height Difference (PHD)

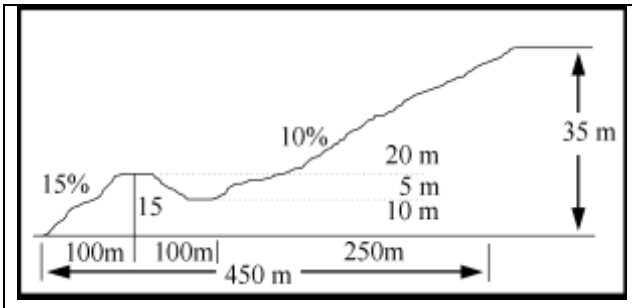
PHD is used to calculate the average gradient of the climb (PHD x 100/distance)



A-Climb

An A-climb is a segment of a course that has a PTC equal to or greater than 30 m. The average gradient must be between 6 and 14%. They typically include short segments that have gradients less than 9%, including negative gradients (downslopes). They may include C-climbs.

The following is a **good** example of a major climb. The main climbing segments (9-18% gradients) are interrupted by some undulating terrain, including a small (5m PHD) segment of downslope gradient:



Specific climb gradient = 15% & 10%

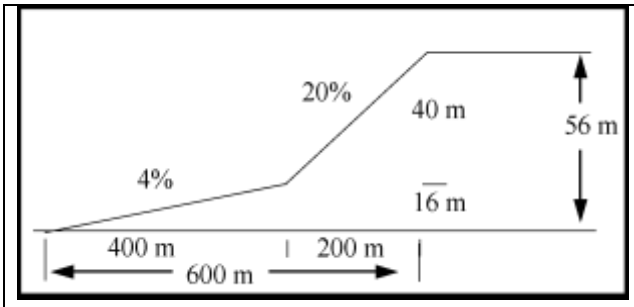
<u>Average gradient</u> of climb = 7,8%

Overall HD of climb = 35m

Added to TC from this climb = 40m.

(15 + 25m)

This following is a **poor** example of a major climb. Even though the average gradient of this segment is within the defined range of 6 - 14%, the uphill segment gradients of 4% and 20% are outside the defined range of 9-18 %:



Specific climb gradient = 4% & 20%

<u>Average gradient</u> of climb = 9.3%

Overall HD of climb = 56m

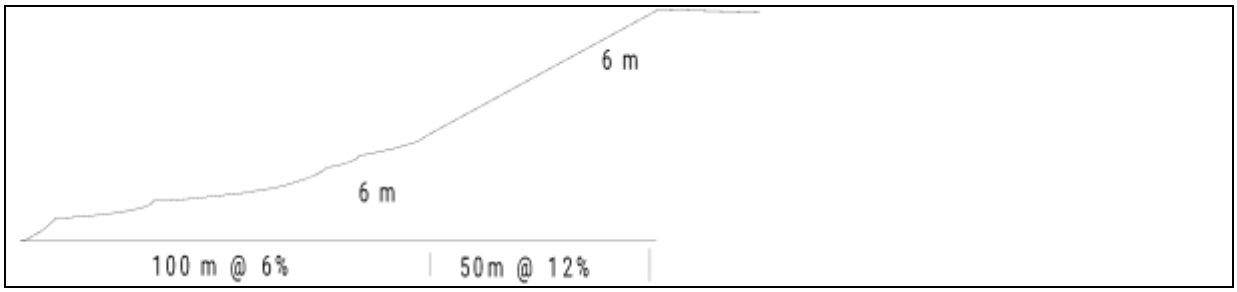
Added to TC from this climb = 56m (16 + 40m)

B- Climb

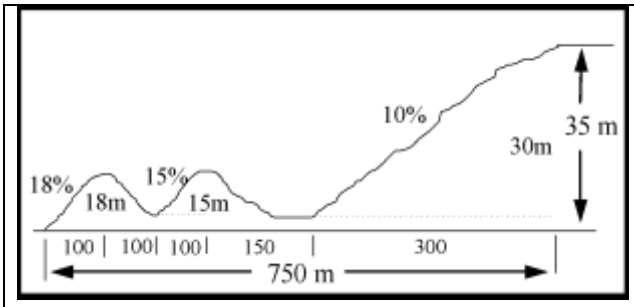
A B-climb is a segment of a course that has a PTC between 10 and 29 m. The average gradient must be between 6 and 14%. They may include short segments that have gradients less than 9%, including negative gradients (downslopes). They may include C-climbs.

The following is an example of a piece of terrain that would be classified as a B-climb.

The PHD is 12 m, it includes segments ≥ 9%, and the average gradient is 8%:



The following example would be classified as three separate climbs, two individual B-climbs and one A-climb.:



Specific climb gradient = 18%, 15% and 10%

Average gradient of climb = 4.6%

Overall HD of climb = 35m

Added to TC from this climb = 63m (18 + 15 + 30m)

Undulating Terrain as part of a climbs

Undulating terrain should normally be part of an A Climb and can be part of a B Climb.

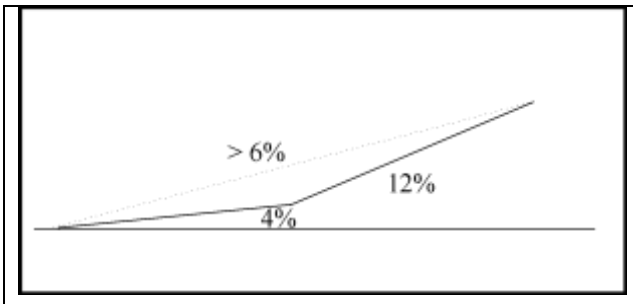
The inclusion of undulating sections within a major climb is based on their location and length. If an undulating section is included as part of a climb it counts as part of the uphills in the overall calculation of the terrain distribution.

When undulating sections occur in the middle of the climb it is a simple situation. If they are less than 150 m in length or include a downhill of less than 10 m HD, the climb is not broken and the overall HD is used to determine the climb's average gradient.

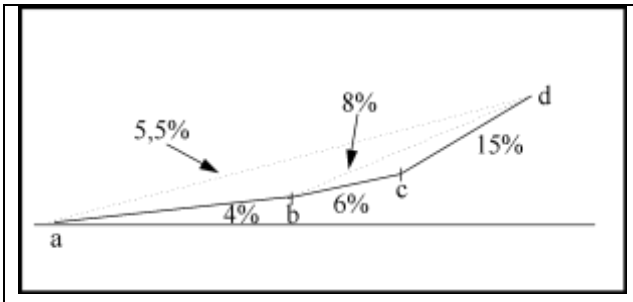
When the Undulating Terrain occurs at the beginning or end of the climb, then the decision to include them will depend on three basic principles:

a) if the average gradient is between 6% - 14% when the segment in question is included
b) sections of uniform gradient must either be completely included or excluded
c) the included segment adds sufficient physical demand to the skier.

Examples:



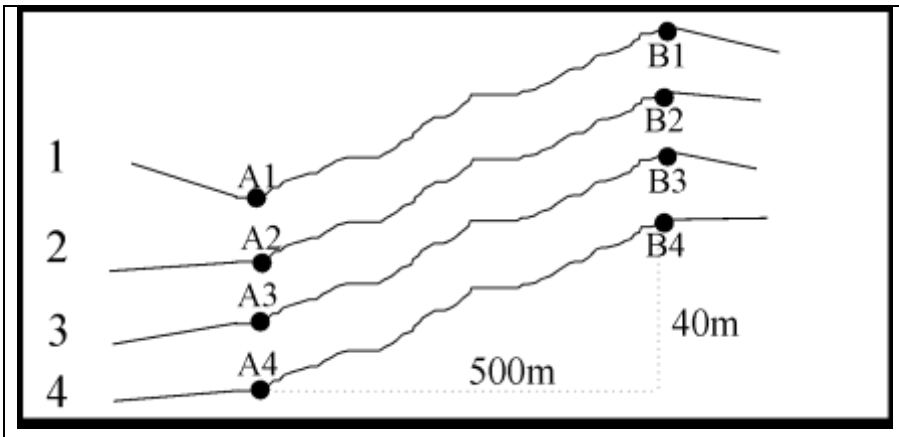
Normally included, providing the 4% section is not excessively long.



The A-climb is from B to D only. The HD from A to B is not included as part of this major climb. AB is an undulating part of the course, and the TC from this section is added to the TC of the course.

Effects of Surrounding Terrain on the Uphill

For course designers it must be appreciated that the following 4 examples represent sections that get progressively more difficult for the skier to ski, yet our classification system would rate them all with average gradient of 8% with HD of 40m from A to B.



In each of these examples, the segment from A to B would all be classified as an A climb.. The nature of terrain before and after the climb can add substantial physical demand without affecting the definition of the climb itself. Even though the specifications are the same for all of the above examples it should be recognized that example no. 4 is much more demanding to ski than the others because of the characteristics of the terrain before and after the uphill section.

Distribution of Climbs

There are many factors that can contribute to the test of the competitor's ability. In designing a course, the possibilities for various types of climbs should be emphasised. A good course should include major and short climbs and a variety of lengths and gradients.

The location of the major climbs along the course is as critical as their total climb or elevation values, and together these factors determine the flow and balance of technique as well as where and when the maximum physical demands are placed on the skier. The location of the major climbs should be spread out along the course, and the course should optimally start with a smaller climb. The most critical climb is towards the end of the course, where decisive action can play out among the competitors. The locations of the climbs will however in many cases be given by the natural terrain and the need to minimize the environmental impact.

The location of major climbs in the terrain is also a primary influence on where the stadium should be placed so that there is good access to the best terrain at appropriate distances along the course. If possible, the ideal solution is to place the stadium close to the middle between the highest and lowest point. The reason for this is that it gives flexibility for course design.

Theoretical Climb Distribution		
Nominal Course Length	A Climbs	B Climbs

Sprint Classic		2
2.5 km	0-1	1-3
3.3 km	0-1	2-3
3.75 km	1	3-4
4 km	1	3-4
5 km	1-2	3-5

A-climbs should represent 20% - 55% of the Total Climb (courses 3.3 km and longer)

B-Climbs should represent 20% – 55% of the Total Climb

Design of downhills

Safety together with technical and tactical challenges for the skier should be taken into consideration when a downhill is designed. A good cross-country competition course includes various kinds of downhills, long and short, steep and slowly falling terrain.

Design of downhill sections must take the following into consideration:

- Downhills should be laid out so that they provide technical challenges to the athletes, and avoid opportunities for drafting (e.g. very long and straight downhills)
- Consideration for the athletes' safety is very important, so corners must be sweeping and with a constant radius, especially at the bottom of downhills. There are formulas developed for how to design downhill corners based on the skier's estimated speed and the radius of the curve (see below)
- High speed downhills must be wide enough such that skiers can get around other skiers in case of a crash
- Dangerous areas adjacent to the course must be fenced or protected (steep banks and ditches, trees, rocks)
- Avoid sections that create compressions such as a high speed downhill followed by an immediate steep uphill
- Avoid high speed "blind corners" where skiers cannot see the bottom of the hill or around the corner etc.

Undulating terrain can be included in a downhill. If those sections include small uphills, the elevation of these uphills also counts to the TC of the course.

In fast downhill curves the need for proper radius and banking must be considered.

The course designer must first consider the relationship between the radius R and the speed V in the curve. The **V^2/R Factor** should be within the maximum values shown in the table below:

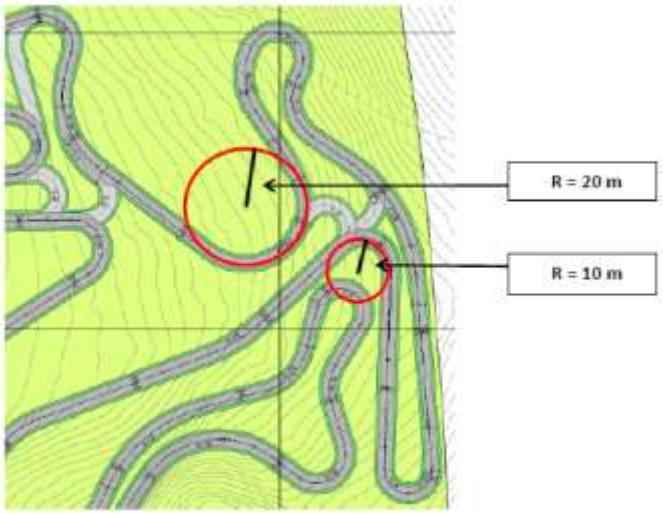
V^2/R Factor	Interval Start	Relay/Pursuit	Team & Individual Sprint	Mass Start / Skiathlon
5	+	+	+	+
10	+	+	+	R
15	+	+	R	-
20	+	R	-	-
25	R	-	-	-

"+" means that the downhill and corner can be used

"-" means that the downhill and corner is not safe

"R" means that the downhill should be reviewed

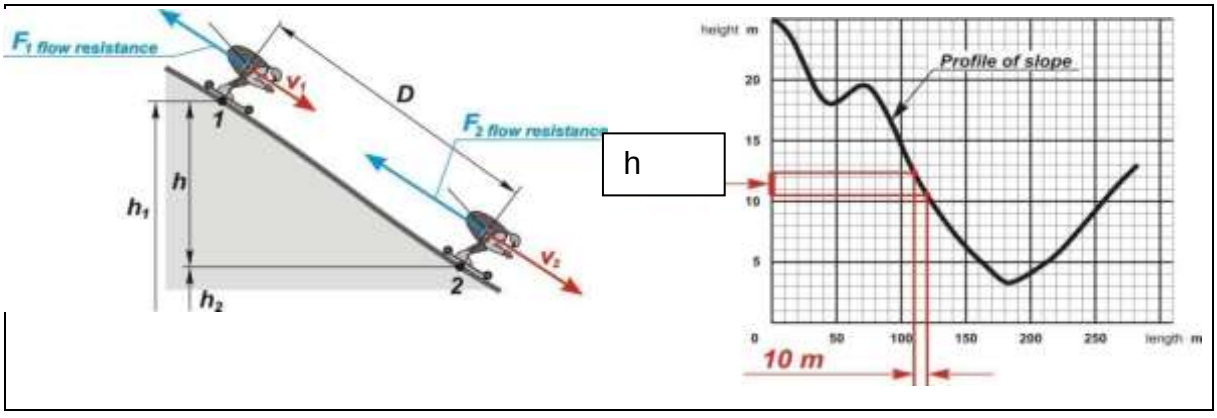
The radius can easily be measured from the course plans (see figure below):



To calculate the theoretical speed is a bit more complicated, but it can be estimated by dividing the downhill into 10 m sections (the detailed profile of the planned course is required) and using the formula:

$$V_2 = \sqrt{0{,}95V_1^2 + 20h - 4}$$

where the variables V_1 and h are as shown on the drawings below.



The speed and speed/radius ratio are then calculated by entering the formula and data into an Excel spreadsheet:

Length	Part-length	HD	PHD	Calculated			
m	m	m	m	speed m/sec	km/hr	V2/R (R=15)	V2/R (R=30)
0				6	21.6	2.4	1.2
10	10	783	-2	8.3	29.8	4.6	2.3
20	10	781	-2	10.0	35.9	6.6	3.3
30	10	779	-2	11.3	40.8	8.6	4.3
40	10	777	-1	11.7	42.2	9.1	4.6
50	10	776	-1	12.1	43.4	9.7	4.9
60	10	775	-1	12.4	44.6	10.2	5.1
70	10	774	0	11.9	42.9	9.5	4.7
80	10	774	0	11.4	41.2	8.7	4.4
90	10	774	-1	11.8	42.6	9.3	4.7
100	10	773	0	11.4	40.9	8.6	4.3
110	10	773	0	10.9	39.2	7.9	4.0
120	10	773	0	10.4	37.5	7.3	3.6
130	10	773	-1	10.9	39.3	8.0	4.0
140	10	772	-1	11.4	40.9	8.6	4.3
150	10	771	-1.5	12.2	43.9	9.9	5.0
160	10	769.5	-1.5	12.9	46.6	11.2	5.6
170	10	768	-2	14.0	50.3	13.0	6.5
180	10	766	-2	14.9	53.6	14.8	7.4
190	10	764	-2	15.7	56.5	16.4	8.2
200	10	762	-1	15.8	56.9	16.7	8.3
210	10	761	-1.5	16.2	58.4	17.6	8.8
220	10	759.5	-1.5	16.6	59.8	18.4	9.2
230	10	758	0	16.1	57.9	17.2	8.6
240	10	758	0	15.5	55.9	16.1	8.1
250	10	758					

=SQRT(0.95*(POWER(E4,2)-20*D5-4))

Course Length & Principles of Multi-lap Competitions

The actual range of the course lengths (up to 5 km) is defined in the International Ski Competition Rules from 95% to 110% of the Nominal Course Length. However, for Nordic Combined and Biathlon courses, where two disciplines (jumping and skiing, or shooting and skiing) are elements of the same competition, the course distances have a more exacting standard. This should be considered when designing a venue that includes those sports.

For competition distances using multiple laps, the course length should be measured from start to start, including lapping sections and excluding sections (finish) not skied during the laps. For horseshoe shaped stadiums, this means normally that the finishing straight is not included in the (one-lap) course length. The entire competition distance is then the length from start and back to start again multiplied by the number of laps plus (+) the length of the finishing straight.

For ski-through stadiums the final loop is normally shorter than the other loops. The calculation will then be the length from start and back to start again multiplied by the number of laps minus (-) the length of the lapping curve.

Ideally, two laps are the maximum number for an interval start competition. This will reduce the amount of passing, minimize interval timing confusion, and provide the best possible video production. A combination of two or more courses can be considered as a single lap provided that the course can be laid out such that there is no confusion to the competitors as to which route to take for continuing on course, lapping, or finishing.

Classical technique considerations

Gradients from 14% – 18% are most suitable for diagonal striding. Course design for classic technique should include segments with at least 6 m PHD at these gradients embedded within the middle to end of the classified climbs. An uphill with these characteristics should be located within 500 m of the Finish.

4. Course Design Consideration for Specific Competition Formats

Interval Start

For competition courses where skiers are mostly skiing one by one, more technical elements (e.g. more curves and transitions) can be designed. An important thing to still consider is that overtaking and passing can take place, for example by including straight uphill sections.

Mass Start

These competition formats are also of great interest for spectators. The course layouted for multi-lap competitions and should provide for a good view of the course from the stadium.

For classical technique competitions, the course should have the capacity to be prepared with a minimum of four classic 4 tracks. The need for turning zones in uphill segments of the course should be minimized.

For free technique competitions, the course width and alignment should be as such that three competitors should be able to ski side by side in all critical parts of the course without interfering with each other.

The start area must be wide and long enough to allow for starting up to 150 athletes at the same time. The slope of the start corridors should be minimized to allow for the competitors to remain still prior to the start.

Congestion points, including sharp transitions from downhills into uphills, narrow sections, and long and steep C-climbs, must be avoided. Narrow sections resulting from a bridge, tunnel, or landform restriction may be included provided that these are not located at a decisive part of the course. Highly technical downhills should not be located before the first significant climb

Approaching the finish, the course layout should focus on allowing for passing. If possible, a climb with PHD of 10 m or greater should be located on the approach to the stadium.

Skiathlon

Skiathlon requires separate courses for mass start classic (C Category) and mass start freestyle (D Category) with a common stadium entrance and exit, or an extra wide course that can accommodate both techniques (E Category). The Skiathlon design principles follow those of the Mass Start.

Special attention must be given in the design of a Skiathlon stadium to the area for equipment exchange. Exchange boxes require 1 - 1.25 m of length per competitor and adequate width for the entry and exit of the boxes.

Val di Fiemme, ITA

Planica, SLO

Individual and Team Sprint

For classical technique competitions, the course should have the capacity to be prepared with a it is required a minimum of four classic 4 tracks and minimizing the need for turning zones in the climbs and undulating terrain.. For free technique, the course width and alignment should be as such that three competitors should be able to ski side by side in all critical parts of the course without interfering with each other.

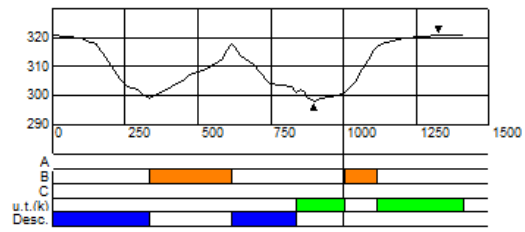
The overall goal when designing a classical technique sprint course is to make sure that the diagonal technique is used, which means hilly enough such that the competitors find it necessary to use the diagonal stride technique or when a reasonable Diagonal Technique Zone can be utilized.

- Include minimum two uphills with gradients of 14 – 18%
- The PHD of one of the uphills should be minimum 15 m (preferably the last one)
- The PHD of the other uphill should be minimum 10 m
- Both flat and uphill sections should include straight sections that allow for passing. Too many curves on flat parts provide an advantage to those athletes using skating skis in classical technique competitions
- A slight uphill gradient towards the finish should be included
- Downhills with curves where several technical and tactical choices of best line is possible, is also recommended

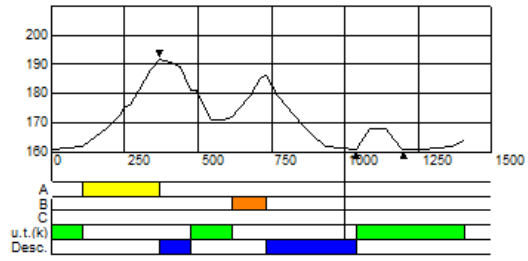
There are no climb requirements for Sprint in free technique. However, it is important to provide significant straight sections that allow for passing and adequate course width for the terrain.

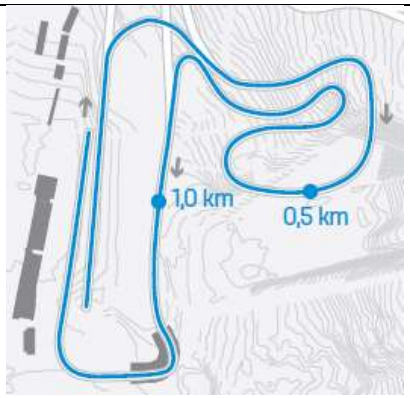
In some situations, the best solution to create a Sprint course with two uphills is to utilize a two-lap course.

Examples of classical technique sprint courses

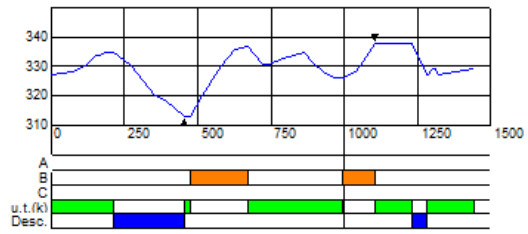


Kuusamo, FIN

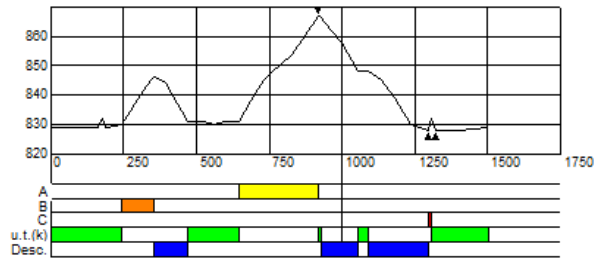


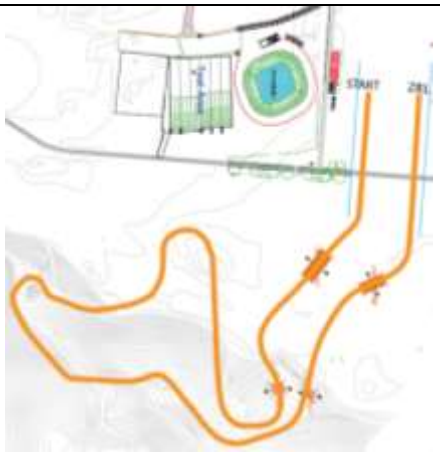


Falun, SWE



Holmenkollen, NOR





Oberstdorf, GER

Relay

Relay competitions are of great interest for spectators, and the course layout should therefore provide for good views of the competition. Generally multiple laps of a 2.5 km or 3.75 km course should be used for relays. If both techniques are used on the same course, the course must be wide enough to accommodate at least two classic tracks plus 6 m for the freestyle legs.

5. Stadium Design

Size, Location and Orientation

. The main objective is to design a stadium such that the athletes and spectators can experience an exciting atmosphere. This means that the stadium should not be larger than absolutely necessary, approximately 50 - 65 m wide and 150 - 200 m long (depending on if it is a horseshoe- or ski-through stadium). A good atmosphere between the competitors and the spectators can then be obtained.

When determining the location of the stadium access for athletes and coaches, officials and volunteers, spectators, media, and video production, must be considered. Space requirements of the user groups and universal accessibility should be considered.

Ideally the stadium should be located within the terrain somewhere in the middle between the highest and lowest point on the course. This would improve the flexibility for course design by permitting access to a greater variety of terrain. Sufficient space must be found adjacent to the stadium in order to provide easy and secure access for the various services for media, team cabins, warm up, wax testing and the start.

Maximizing the benefit of exposure to the sun is important for a successful atmosphere. The stadium should be oriented in such a way that the main spectator area is in the sun, and that the athletes have the sun in their faces as they approach the finish line. For optimal TV exposure and atmosphere, it is usually preferable to have spectators on both sides of the stadium.

Functionality

General

To plan for the highest level of competitions, the access for all categories of people to their designated positions without interfering with each other is of paramount importance. For example, the competitors should be able to reach the following areas without being disturbed by other groups:

- the team preparation area (wax cabins)
- the ski testing area and the warm-up tracks
- equipment control
- the storage for warm-up clothing
- the start
- the through lap or relay exchange (with exit to the mixed zone)
- the finish
- the ski control after the finish line
- the immediate care area (tents for the exchange of clothes, refreshments etc.)
- the exit

Athletes and Teams

The stadium :

- Easy and safe (non-slip) access between wax cabin service area, warm up track and start
- Provide fair start and finish conditions for all of competition format
- Provide good conditions for clothing and feeding services at the start and after the finish.
- Sufficient space for coaches, competition equipment and final warm up
- Good visibility to the scoreboard and video screen
- Adequate space for lapping lane, pit stop for equipment change and relay exchange zone

Video production and Media

To obtain good media conditions the following must be prepared:

- unobstructed camera positions
- Facilities for photographers, writing journalists, radio and TV reporters. The detailed organization of these facilities should be done in cooperation with press people who will function in the start and finish area
- Rooms for press people and press conferences that are close to the start and finish area
- High quality and quantity of electrical power and internet connection
- A parking area for production equipment
- Provide something that gives the stadium its own unique identity (mascot, art installation, etc.)

Mixed Zone

The mixed zone must provide space and working conditions for many groups. The overall size of the mixed zone will depend on the level of the event, where the highest requirements are for the World Championship and the Olympic Games.

Space for the following groups must be considered:

- TV Host broadcaster
- TV Rights holders
- Radio
- Electronic network gathering (ENG) crew
- Photographers
- Writing press
- Ski racing/industry supplier (SRS) representatives
- Doping control personnel
- Ski patrol/medical (when needed)

Planning solutions for all of these different needs, while keeping the athletes as a primary focus, requires active input from all groups working in the stadium. Looking at previous models from other successful organizers is a very important first step.

Examples of mixed zones are included in Section 7 of this manual.

6. Additional Competition Infrastructure

Waxing cabins

Waxing cabins have to be located so that the access to the Start/Finish area is unobstructed, safe (non-slip) and separated from spectators and media. The cabins can be in halls, tents, trailers or permanent buildings. For high-level events, each participating team and FIS equipment supplier should have their own cabin that can be locked in order to store the material under safe conditions. The size of the cabins (or space) should as a minimum be in accordance with event rules

In the cabins the installations should include:

- Several electric outlets
- Adequate heating and ventilation
- Shelves
- Waste bins
- Security installations
- For wax trucks, special power is required, and flat parking area is required, and the venue owner must be aware of this
- In addition to waxing cabins, separated changing rooms for women and men should be provided. In this area also enough toilets must be installed.


Wax cabins Sochi 2014

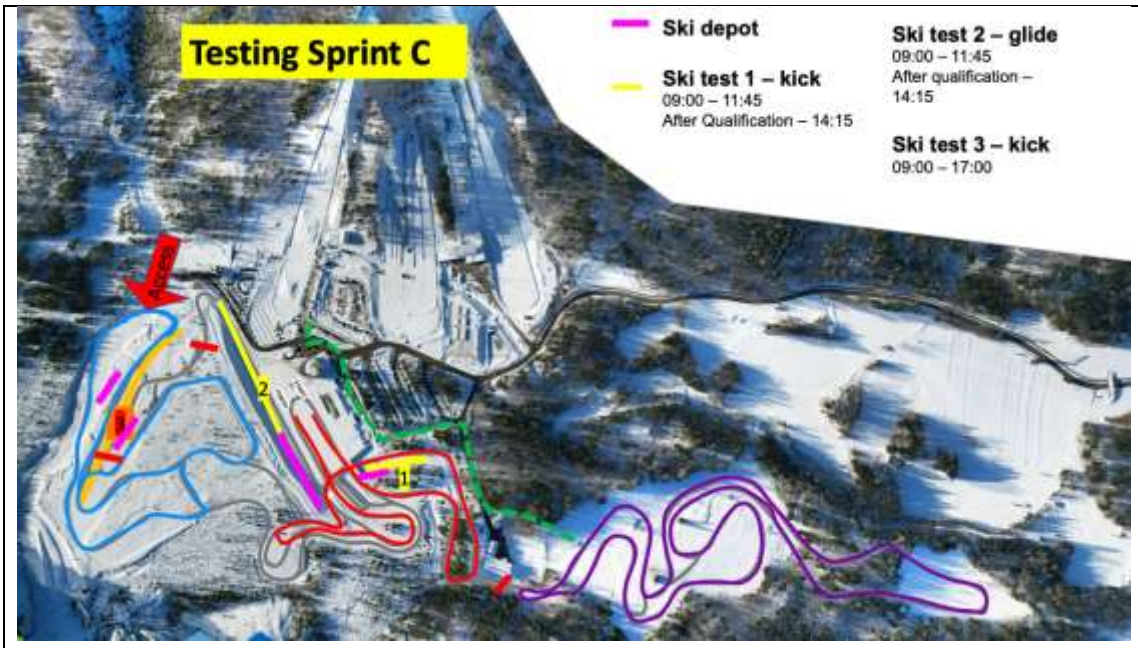
Ski test area and ski depot

Planning of ski test areas is very important. The testing areas should have a hill that can accommodate uphill testing of grip wax and a long glide out from a medium high speed. Course designersshould look for suitable areas along the course where extra width can easily be added. If the course is wide enough, ski testing can take place on a separate lane (marked with V-boards or fences) adjacent to the competition lane as long as it does not interfere with the warm-up, competition or video production.

If two or more totally different snow conditions can be expected on the same course, multiple test areas along the course should be designed.

It is also desirable to identify a testing area in the vicinity of the wax cabins that can be used during periods when the competition course is closed.

In the process of using the ski test areas along the course, the teams also need an area to stage the test skis. Therefore, a ski depot area should be planned adjacent to the testing areas where the wax technicians can store the large number of different test skis without interfering with the flow of training athletes.



Planica, SLO

Warm up and training courses

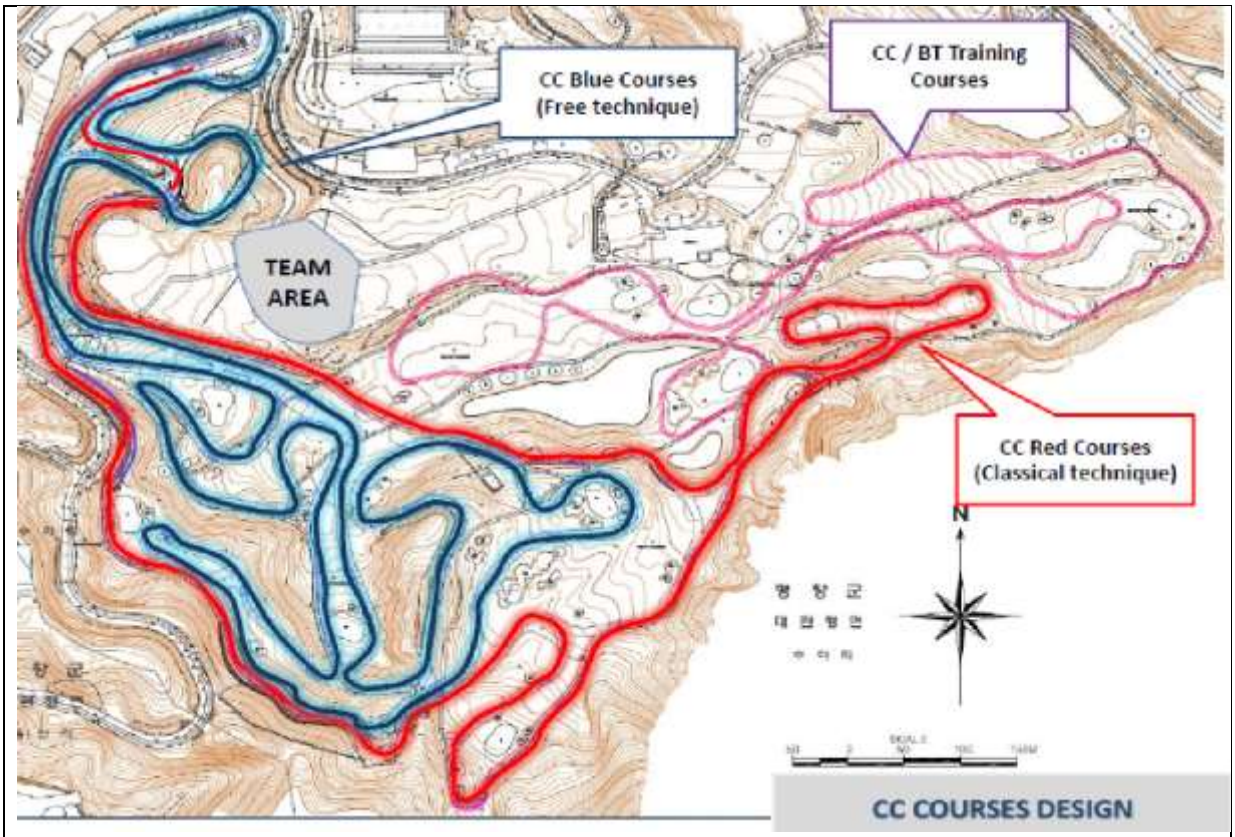
The need for a separate warm up and training course is mostly related to the competition formats individual start and relay. In these two formats competing athletes are on the competition course while athletes who have not started need a separate warming up course. For mass-start competitions the skiers can often warm up on the competition course.

The warm up courses should be designed in a way that provides use of all cross-country skiing techniques. Since many skiers are expected to be on this course at the same time, safety precautions should be considered. Blind corners, steep downhills and narrow passages should be avoided. The length of warm up courses should be approximately 1 km. This course can also be the course that provides access from the wax test area to the competition courses.

Unused parts of the competition courses can be used for warm up purposes. Individual start formats in classical technique do normally not require the whole course width. Therefore, half of the width can be used for competing athletes while the other half can be used for athletes warming up.

If a warm up course is used in both directions the course should be 10 m wide. The warm up course should provide for the same snow conditions as the competition courses, and special consideration should therefore be

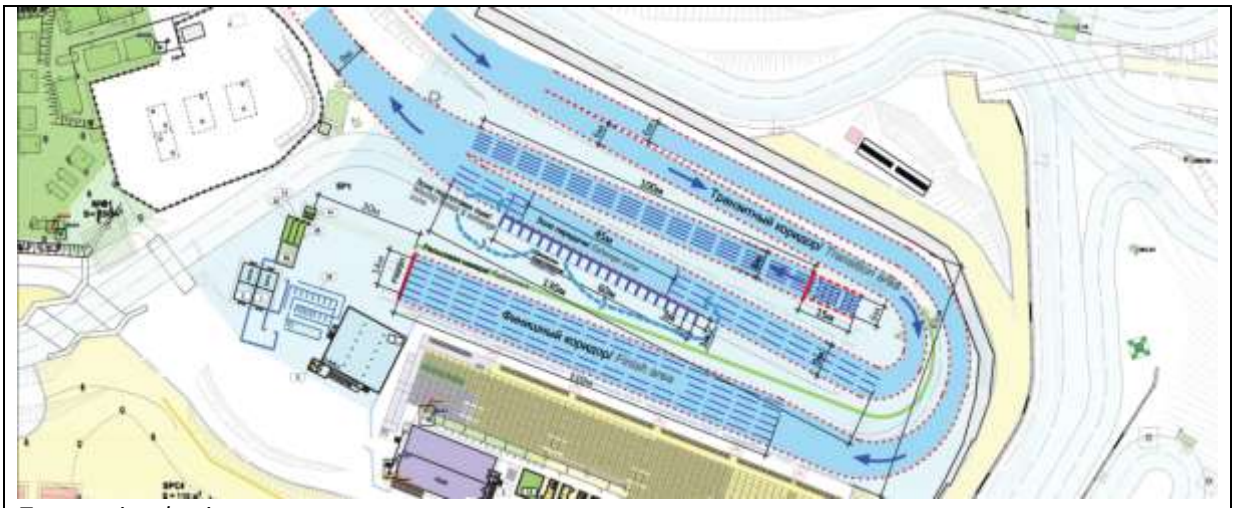
paid to the sun exposure. It has to be noted that for mass start competitions, where there is time for it, the warm up for the athletes can take place on the competition course.



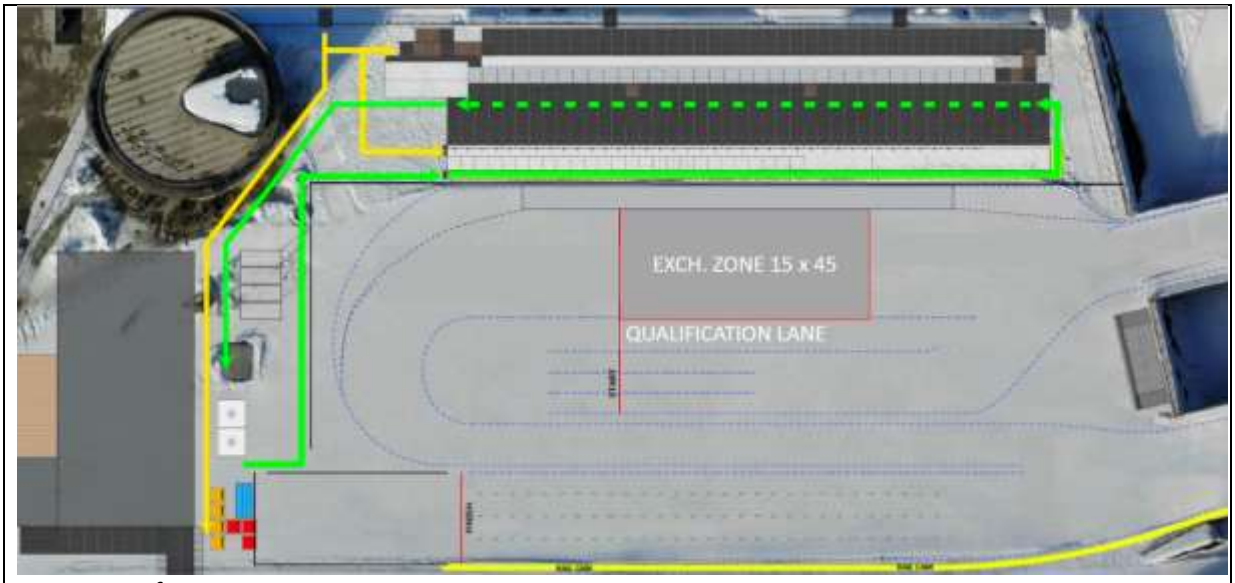
Venue showing competition courses and warm-up and training courses (KOR)

Examples of Stadium Configurations

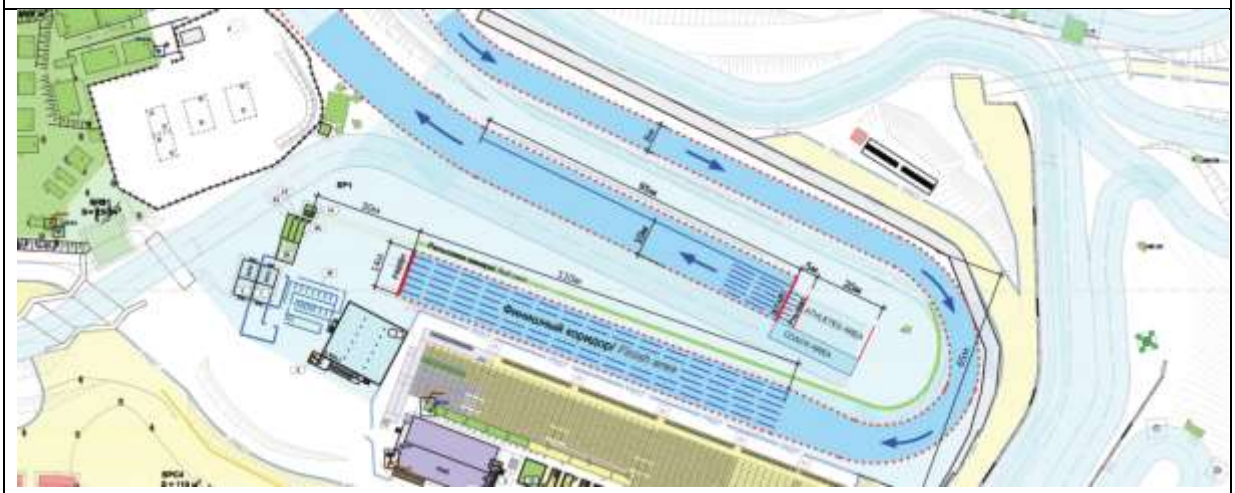
The pictures below (from Sochi OWG and Planica WSC) show stadium layouts for different competition formats.



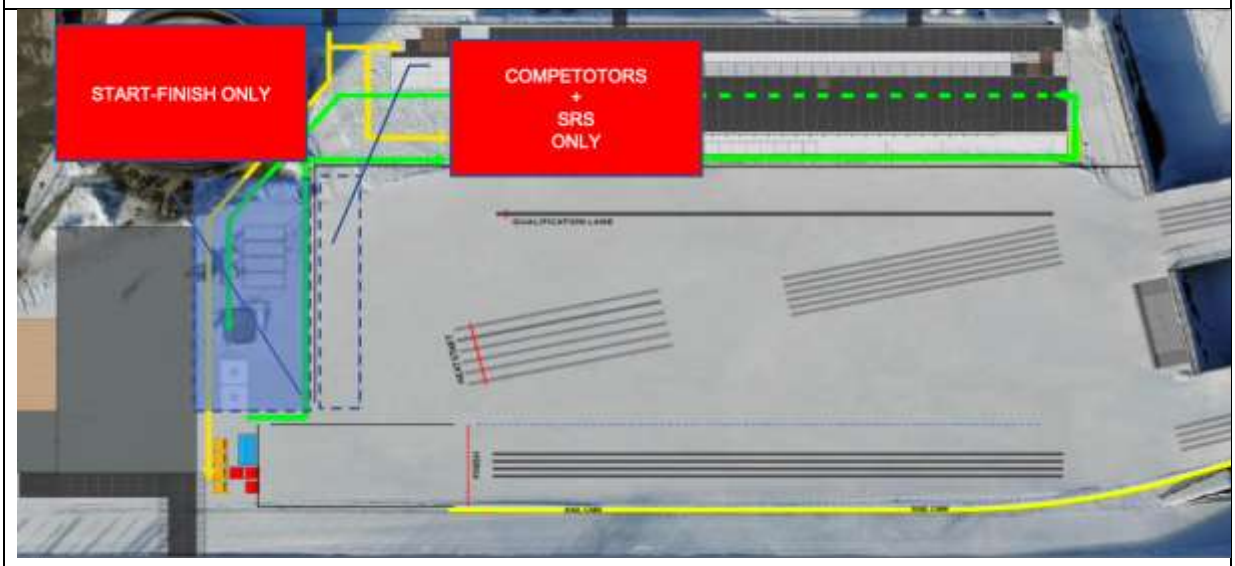
Team sprint classic



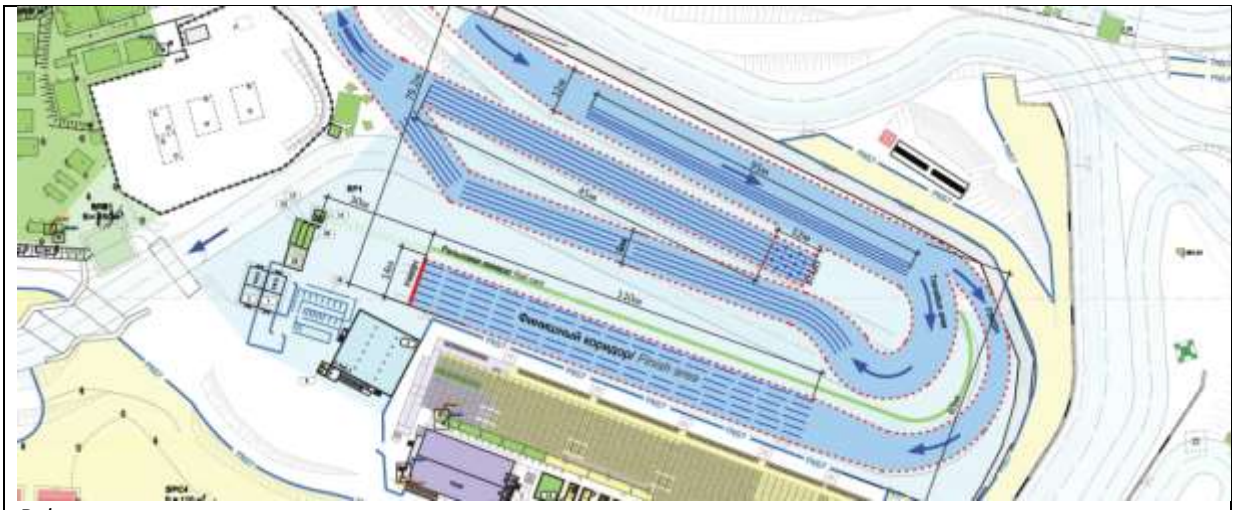
Team sprint free



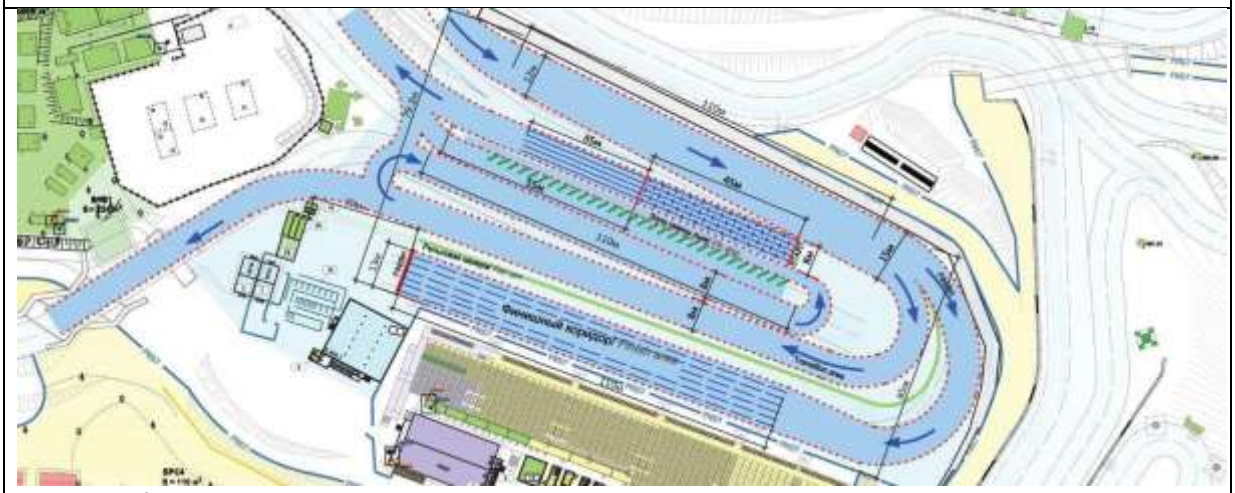
Sprint free



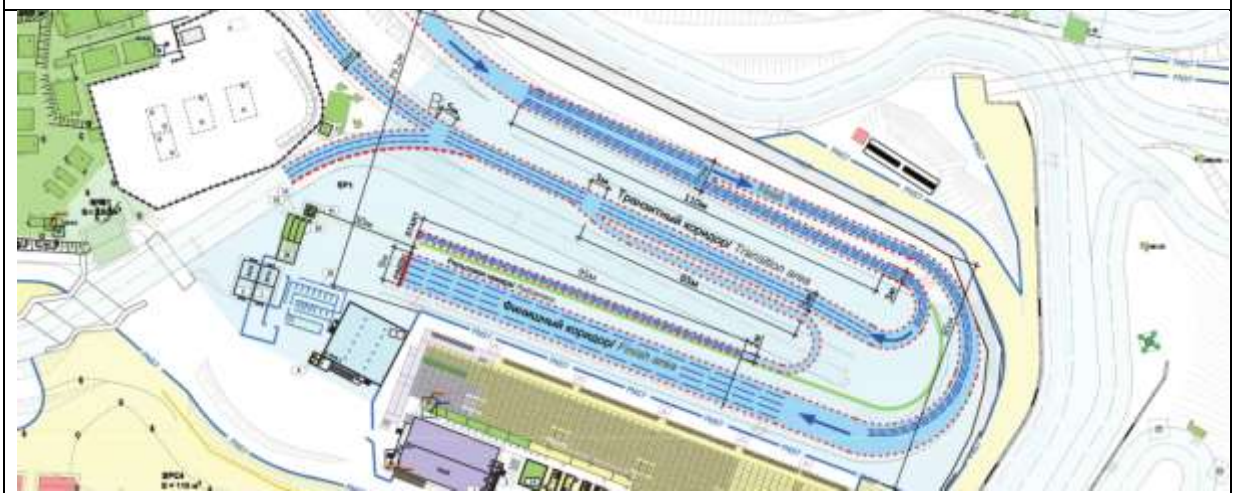
Sprint classic



Relay



Mass start free

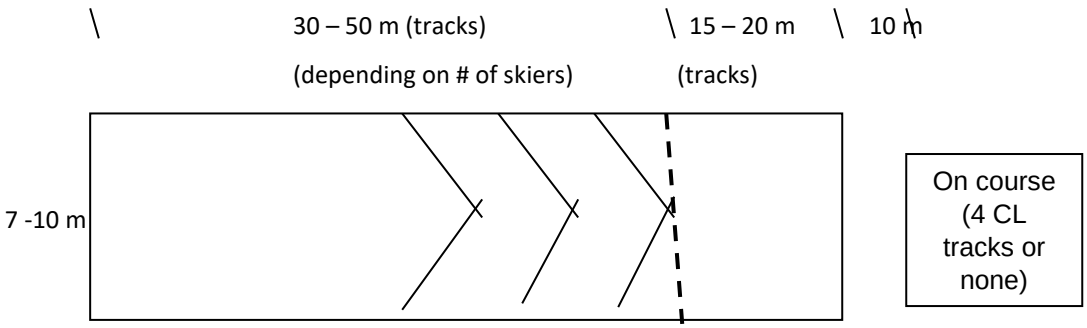


Interval start classic

Overview of skiathlon stadium setup (Falun, SWE)

Mass-start grid

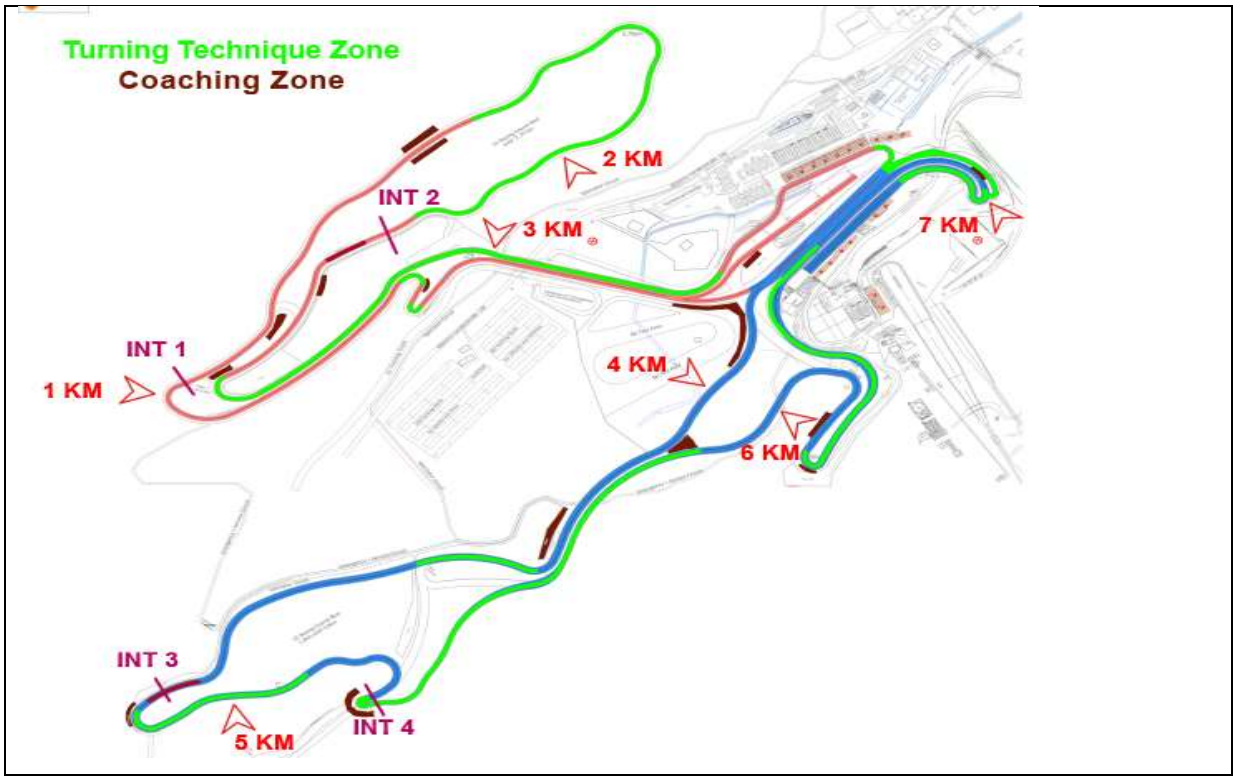
The following shows space requirements for a mass start (WC, WSC, OWG and JWSC):



For competitions in Classical technique the 5 or 7 start tracks should transition into 4 tracks on the course. The start tracks should be set 1.2 – 1.5 meters apart. For competitions in free technique the same 5 or 7 classical start tracks should transition into the free technique course.

Crossing of courses in the stadium

It is in general not advised to have courses where the skiers must cross each other's path during the competition. However, to avoid costly bridges this is sometimes possible in straight sections with good views – for example inside stadiums. Below (see next page) is an example of the Seefeld stadium where a crossing was possible during the long-distance competitions.

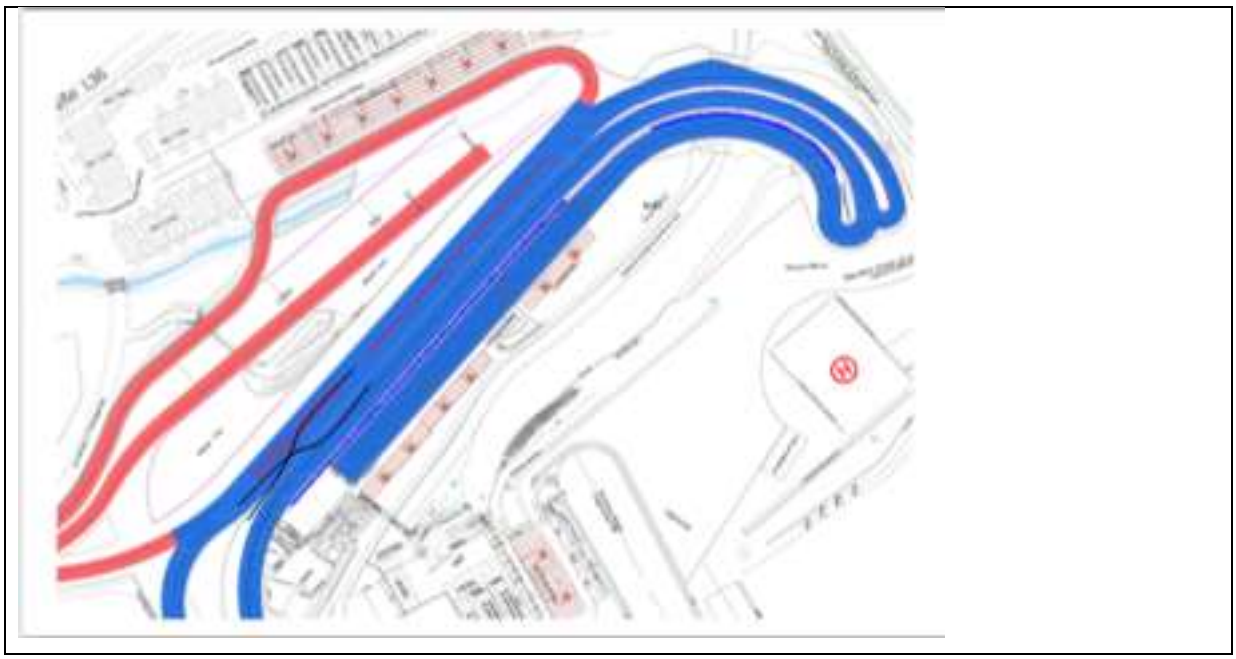


Situation:

Skiers could come from the red course and go over to the blue course while at the same time skiers could come from the blue course and go over to the red course for the second loop. It could happen that interference could take place since no bridge was built.

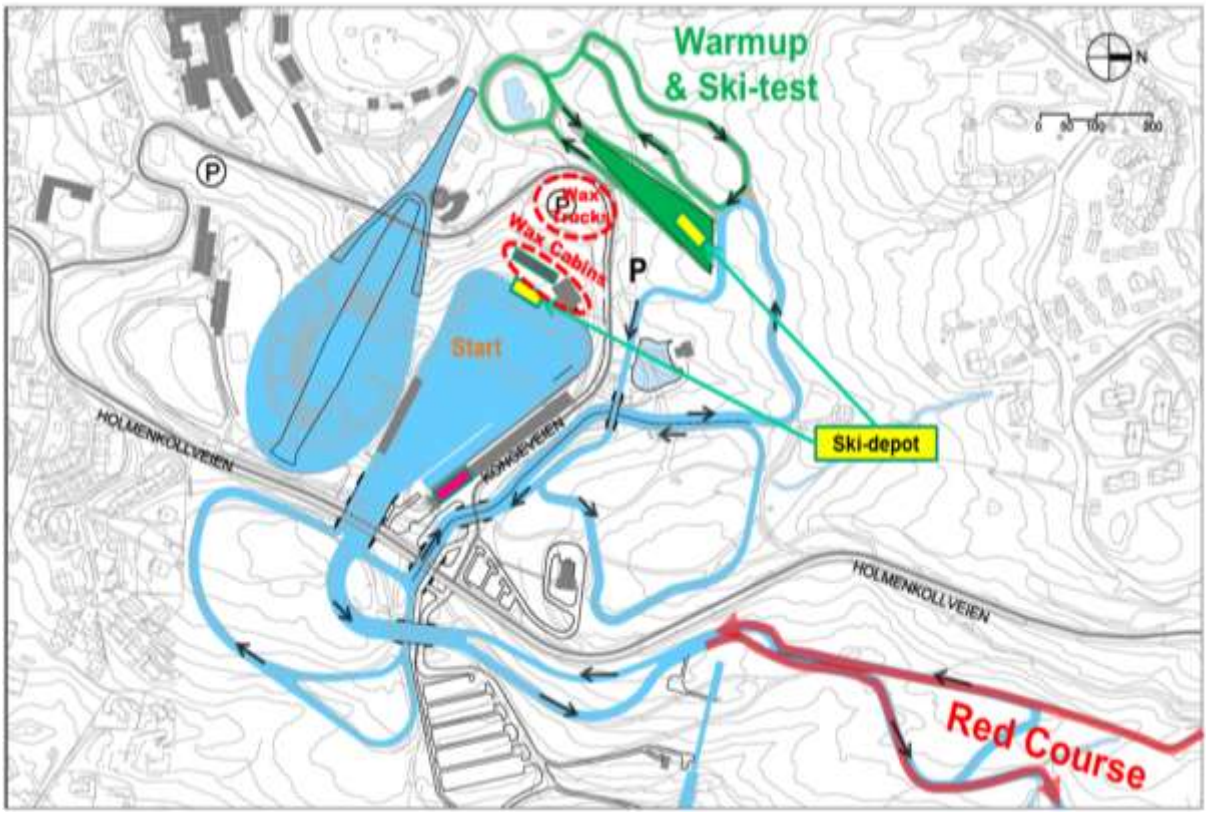
Solution: A 50 m long zone was introduced where the two courses were parallel, see the 2 red lines on the stadium drawing, where the crossing should take place. For the crossing see the 2 black lines.

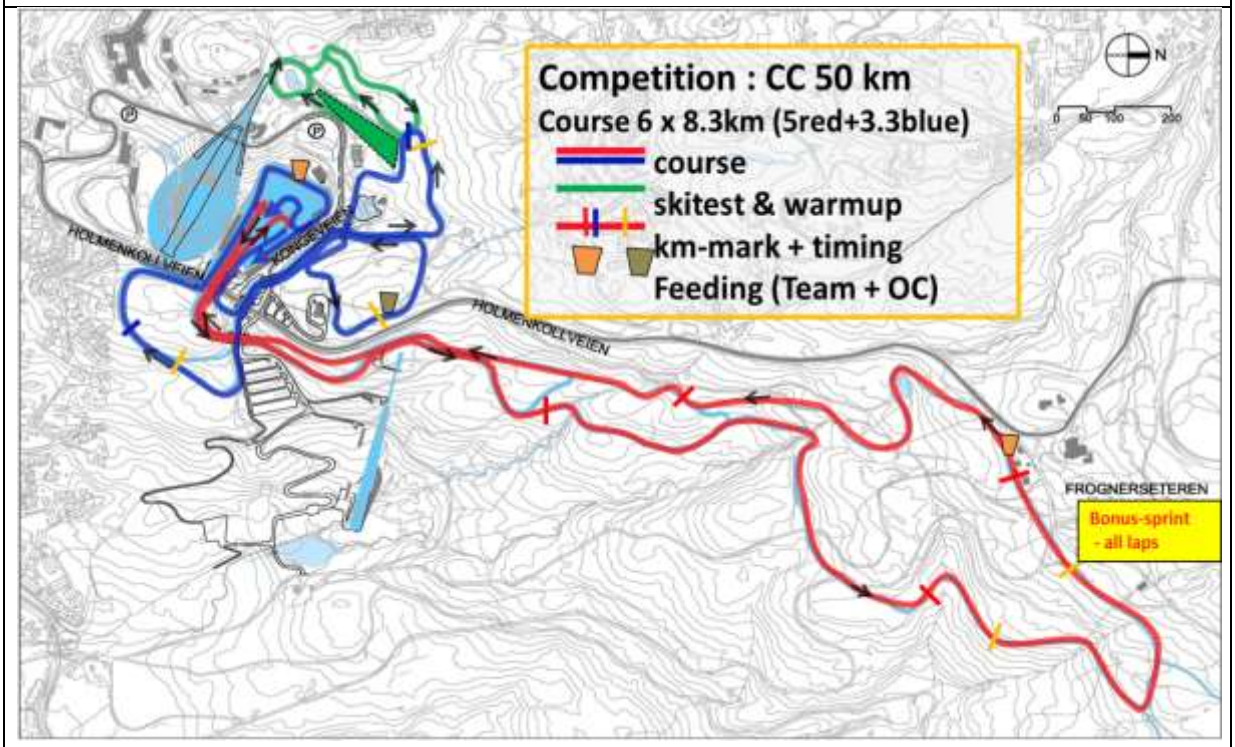
The WSC organizer saved money, and a bridge in the middle of the stadium would have been considered as a disturbance.



7. Venue Design

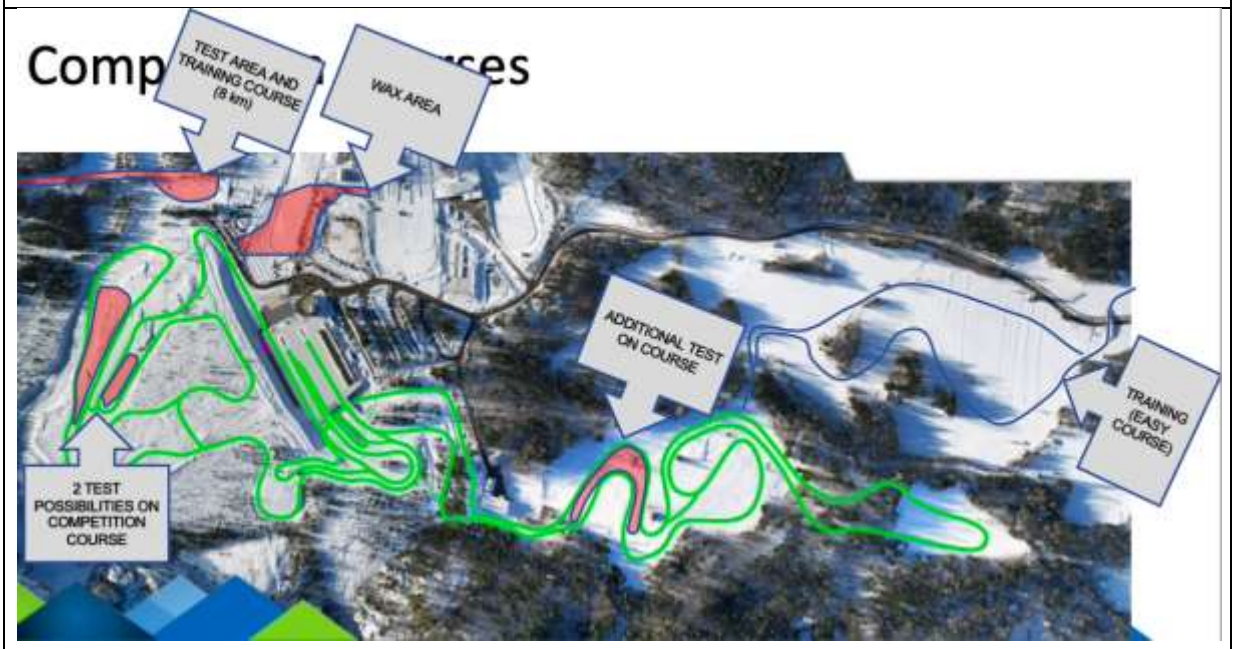
Venue layouts and other examples



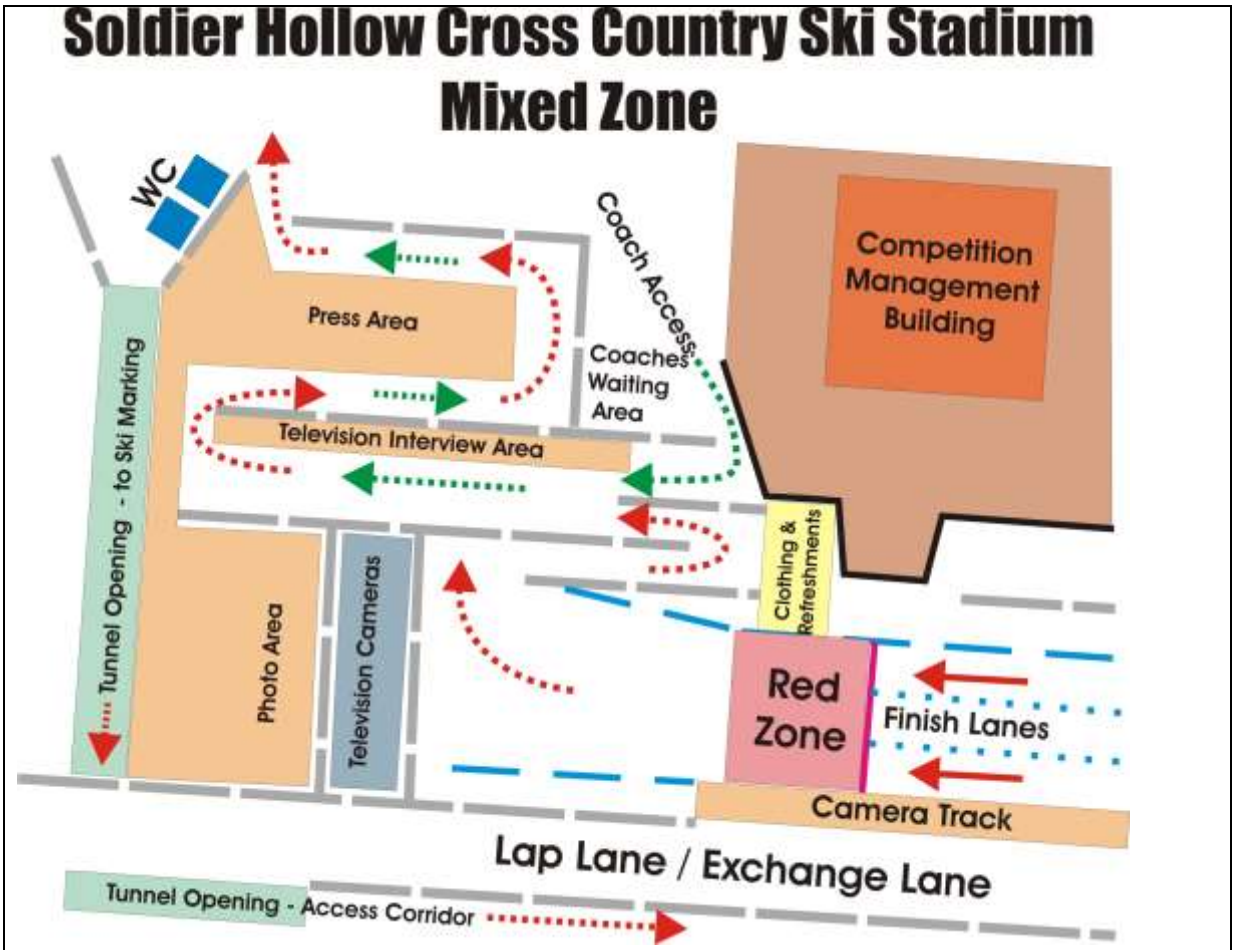


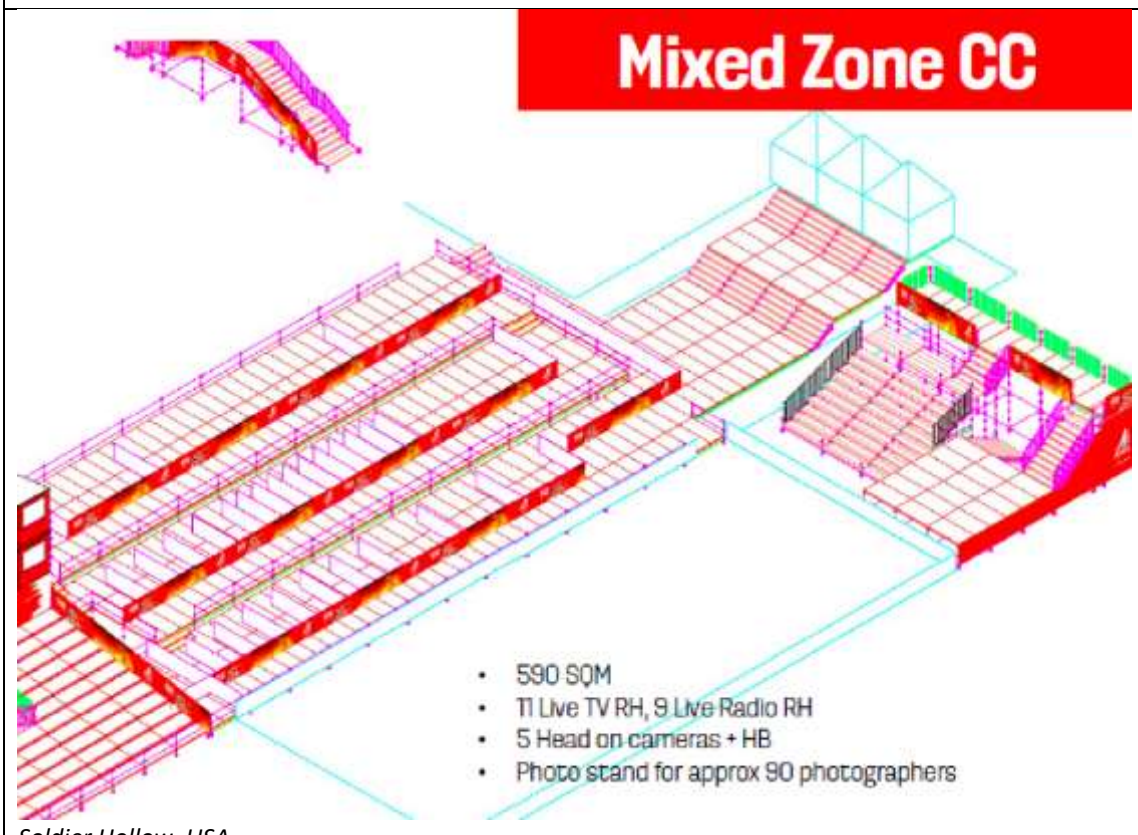
Holmenkollen, NOR


PLANICA
FIS NORDIC WORLD SKI CHAMPIONSHIPS
2023
PARKING OVERVIEW
PLANICA
KRANJSKA GORA - PLANICA.....6,5 km
PODKORENI - PLANICA.....5 km
RATEČE - PLANICA.....1,6 km
P2 SRS-CC
P1 TVC1
P3 TEAM1
P4 TVC2
P7 VIP
P6 TVC3
P8 TEAM3
P5 TEAM 2
P9 LOC 1
P11 LOC2
P10 HOTEL

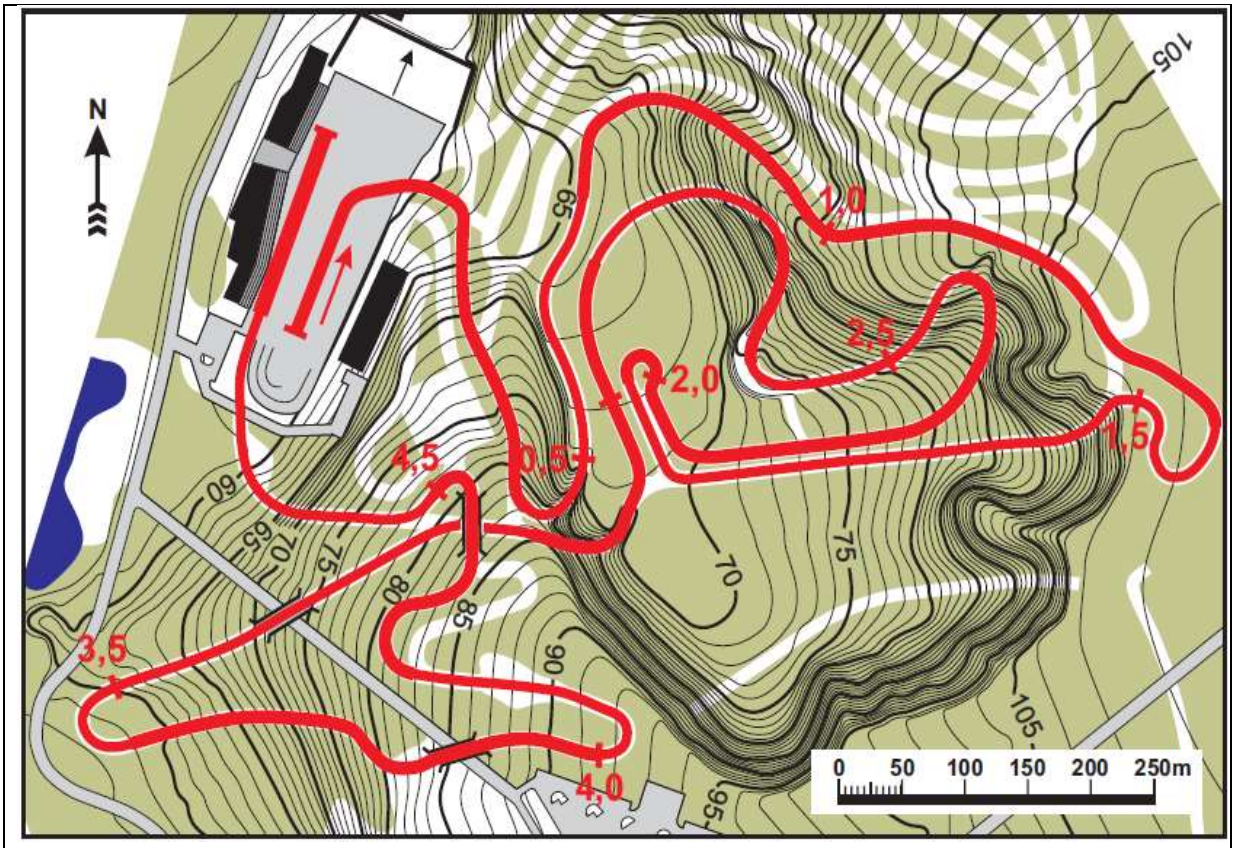

TEST AREA AND TRAINING COURSE (8 km)
WAX AREA
ADDITIONAL TEST ON COURSE
TRAINING (EASY COURSE)
2 TEST POSSIBILITIES ON COMPETITION COURSE

Planica, SLO





Soldier Hollow, USA



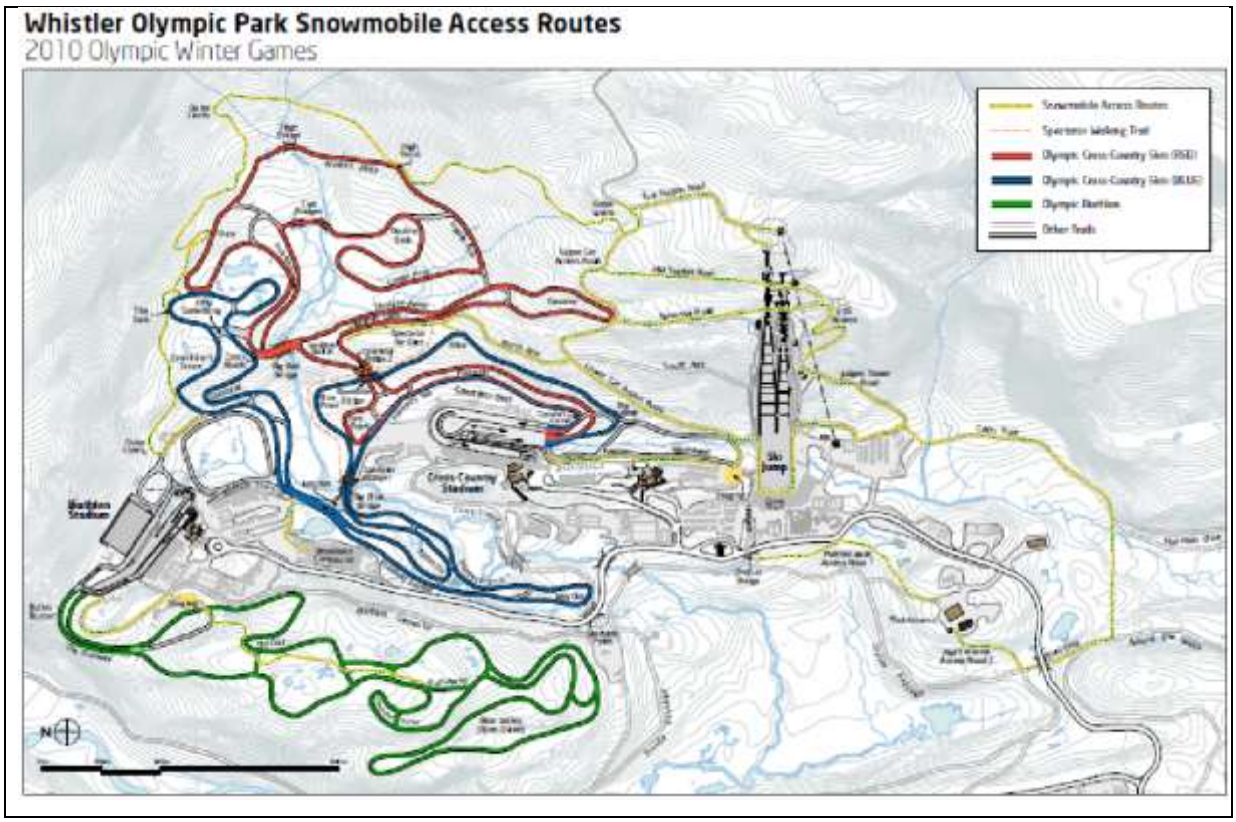
Detailed course plans with clear contour lines (Tyumen, RUS)

Course plans on top of satellite photos (PyeongChang, KOR)

Access Paths

Supporting personnel and their equipment need to be transported to their positions the day of the competitions without damaging the groomed competition courses. These people include medical responders, competition officials, video production and branding teams. Venue design should include creating paths to keep this activity off the competition course as much as possible. They can be narrow trails through uneven terrain but must be constructed such that a snowmobile with a passenger and/or a trailer can travel safely.

For major events, these paths can be quite elaborate. Below is an example from the 2010 Olympic Games (the yellow line marks snowmobile paths).



Appendix 1

Basic venue design procedure

For new venues, Course designer's involvement and work normally consists of the following steps:

Step 1: Conducting a brief survey of the terrain to get an impression of the area

- Course map provided (by the OC) with scale 1:5000 with 1 or 2 m contour lines (5 m is also acceptable).
- Old courses to be visible on the maps
- Plan of stadium provided (by the OC) with scale 1:500

Step 2: Together with the venue owner, the NSA or the OC requesting the homologation, defining the initial sport masterplan that includes the following elements:

- Courses (with approximate distances)
- Stadium with location of buildings
- Access roads or paths
- Parking areas with location of waxing cabins/trailers
- TV compound
- Ski test and ski depot areas, and warm up course

Depending on the requirements for this initial plan, the venue owner/OC may need to bring in a mapping resource/expert.

Step 3: Providing input to the design and construction team (engineering company or OC) on the collection of preliminary course data and production of the following information:

- Professional stadium and course maps
- Exact measurements of the course alignments (length and elevation, width specifications for the different course sections)
- Extract profile data for courses (normally in Excel format)
- Data points with distance and elevation at start and at every 20 m throughout the whole loop for each course (alternatively data at every point where the gradient changes)

Step 4: Verify that the preliminary elevation data meets the the FIS ICR requirements.

Step 5: For World Cup or OWG/Championship courses, the course designer should involve a TV expert

Step 6: After agreeing on the course layout, the venue owner, OC or respective organization must start the legal and regulatory process. The legal process often consists of:

- Agreement with landowners (private or publicly owned land)
- Confirmation from local, regional and national authorities
- Identification of restricted areas - for example regional park status
- Surveys likely to be concluded are:
- Area zoning review
- Environmental review
- Biological review
- Archeological/cultural review
- Special considerations – for example if native people have certain rights or requirements

Step 7: When the paper-plans are confirmed, a detailed assessment of the terrain must be done:

- The organizer takes part and if necessary, invites local authorities
- The plan is taken from the paper to the terrain
- Adjustments from the paper-plan are noted (trees etc. are marked)
- Necessary adjustments are made such that the best terrain options are selected:
- Use depressions in the terrain where the snow is normally deeper
- Avoid sun exposure
- Minimize sidecuts
- Consider water drainage

Step 8: Construction phase

- Site inspection visits for review and feedback by the course designer should be made at 50% and 90% of construction project completion

Step 9: When the construction work is completed, the final inspection takes place together with the Homologation Inspector (see below)

- Final measurements are done, and an update of the profile data is completed
- Corrected data must be entered into the homologation program