

# FIS HOMOLOGATION SEMINAR SEEFELD /AUSTRIA SEPTEMBER 18-20,2015

- Design of rollerski (terrain) courses

(John Aalberg)



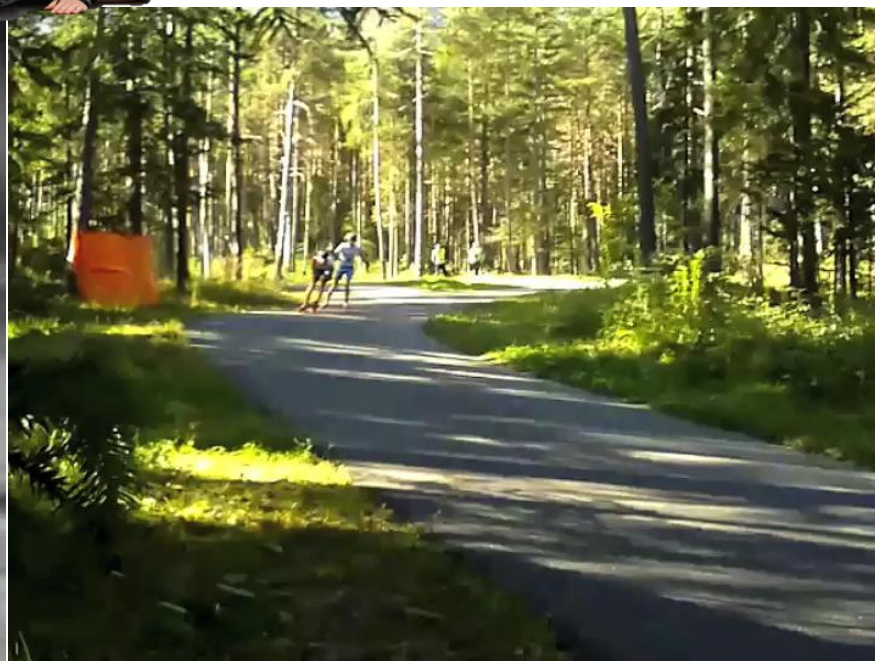
# GOALS

- To increase safety compared to rollerskiing on roads
- To design and construct long-lasting and safe courses
  - With special emphasis on downhill curves
- To meet technical demands for all users?
  - Children 10 – 16 year
  - Juniors
  - Senior/elite
  - Recreational skiers
  
- There are no current rollerski course design guidelines or homologation requirements

# SAFETY ASPECTS

- More rollerski courses will keep users away from traffic
- Existing rollerski courses in the terrain are however often more technically demanding than roads, so to avoid accidents:
  - Avoid sharp corners at bottom of downhill
  - Design correct radius and cross-slope (super-elevation) on corners
  - Install proper protection
  - Implement good signage - directional arrows, «no entrance», warning for steep downhill, mark outside of asphalt with white line, etc
  - Design fences and special signage to avoid foot (or animal) crossing in downhill sections
- Width of paved course should be minimum 3 meters, optimally 4 m (if allowed by regional regulations) or even more if designed for competition. Asphalt should optimally be wider in fast corners (5 – 6 m), in uphill (6 m) for overtaking, and in stadium (8 -10 m for start-area and finish-area)

# Safety matters...



# CONSTRUCTION ASPECTS

- Compared to «winter courses», take extra consideration regarding:
  - Trees, stumps and large rocks - must be removed or covered with protective material
  - Drainage – design ditches in correct places, use more pipes to get rid of water, avoid compressions or flat sections where water pools
  - Must build the roadbase correctly to avoid cracks, frost damage and compressions :
    - Foundation layer (30 cm+) with large rocks
    - Drainage layer (30 cm) with crushed rocks
    - Top layer with finer, natural soilmaterial
    - Should let settle for 1 year before adding asphalt
  - Then one sterile fine sand/fine gravel material before two top asphalt layers
  - Add compressed soil and grass on shoulders of asphalt (extra wide on downhill corners - 2 meters?)
  - Include enough lighting (higher LUX than required for winter skiing)

# DESIGN ELEMENTS FOR ROLLERSKI COURSES

## Definitions (skiing)

From FIS alpine:

- Demanding corners: Speed  $>20$  km/hr and radius  $< 30$  meter

From FIS CC:

- Demanding uphill: PHD  $>30$ m and gradient  $> 15\%$  (?)

From IPC Nordic:

- Max uphill for sit-skiers: 12%

From NorwegianSki Federation:

- Recommendation for youth competition courses:
  - MC should be less than 0.75% of total course length
  - HD should be less than 1.5 % of total course length
  - TC should be within 2 – 3.5 % of total course length

# DESIGN ELEMENTS FOR ROLLERSKI COURSES

**Recommendations** from 2013 Master theses at Norwegian College of Engineering (NTNU) - Per Sigve Selseng, Trondheim

- Review and evaluation of 9 different rollerski venues/courses in Norway
- Interviews with venue owners
- Survey/questionnaire of users from all categories (390 skiers)

## General

- Many alternative loops with different level of difficulty

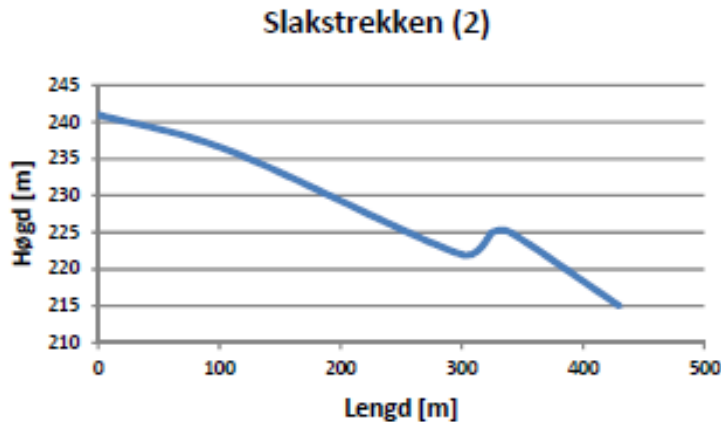
## Uphill design

- Use standard FIS homologation recommendations for total climb TC (but design for lower part of range)
- TC per km should be close to 30 meters (and not towards 35 meters)
- Should include A-hill, but variation of gradient of hill is important
- Avoid C-hills
- Avoid hills with over 15% (to meet wishes of youth skiers)

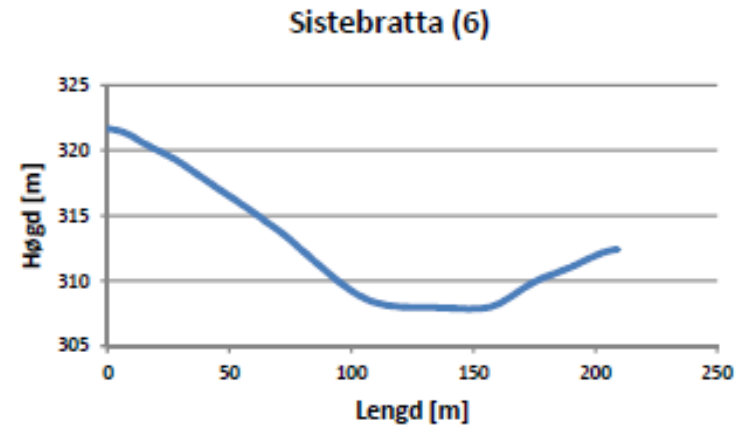
# DESIGN ELEMENTS FOR ROLLERSKI COURSES

## Downhill design

- Fast downhills are ok, as long as they are straight and without «hidden corners»
- Elements for breaking the speed should be implemented:



Figur 48: Døme på utforbakke med «bremsekul»



Figur 49: Døme på utforbakke over i motbakke



# DESIGN ELEMENTS FOR ROLLERSKI COURSES

## Design of corners/curves

Test with bicycle prior to paving

or

be more professional and use following steps:

1. Estimate/calculate speed into corner/curve [km/t]
2. Select proper radius of curve [m] based on speed
3. Select proper super-elevation / cross-slope through curve [%]

NOTE: If curve is already set (course already exist) in step 2, then select proper «banking»/cross-slope based on radius and speed

# DESIGN ELEMENTS FOR ROLLERSKI COURSES

## Step 1 - Calculate speed into the corner

The height difference (PHD) and length of the downhill (L) into the corner will determine the rollerski speed at the entrance to the corner.

Based on testing of speed with #2 rollerskiwheels (3 times for each downhill) and other measurements (in master theses) of over 30 corners, the following formula can be applied to estimate rollerski speed:

1. Calculate formula (called *Heightgradient*):  $PHD^2 / L$  (square of PHD divided by Length)

Example: PHD = 12 meter, L = 60 meter

$$\text{Heightgradient} = (12*12) / 60 = 144 / 60 = 2.4$$

2. Find speed from «Speed-curve» (see next page).

NOTE: Speed on rollerskis with increase with temperature

# SPEED-CURVE FOR ROLLERSKIING

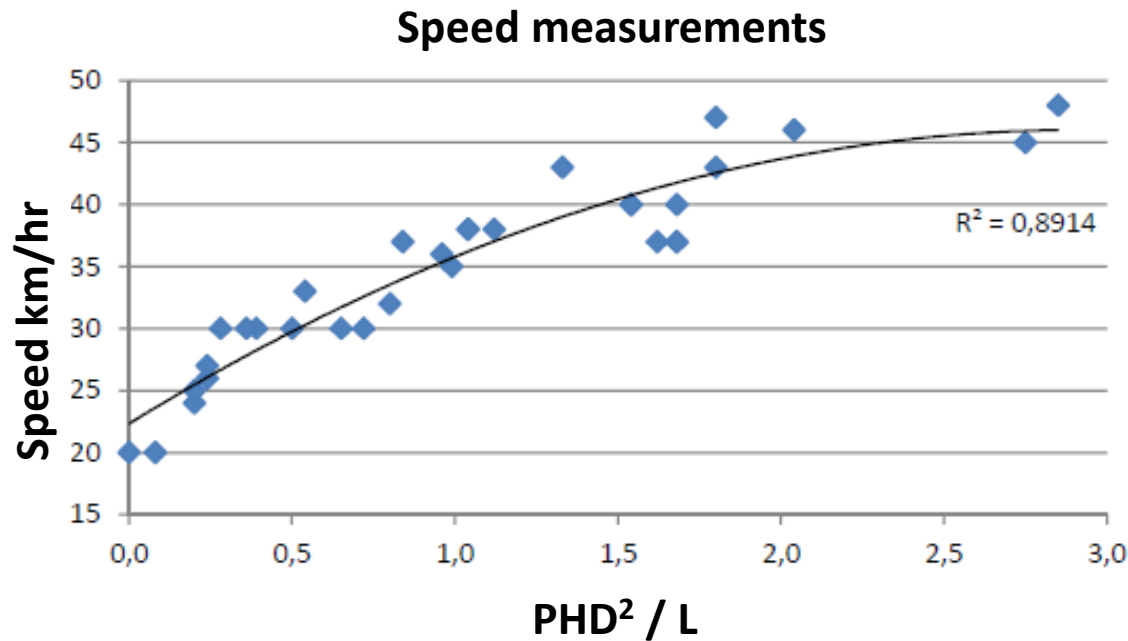


Figure: Speed measured in downhills compared to heightgradient

# DESIGN ELEMENTS FOR ROLLERSKI COURSES

Step 2 and 3 – Choose proper radius and cross-slope/ «banking»

Find appropriate radius and cross-slope from the following table (based on evaluations in the master theses):

**Table: Suggested radius and cross-slope of curves**

Radius / Speed	< 30 km / hr	30 – 40 km/hr	> 40 km/hr
< = 12 m	7 – 11 %	16 %	Not recommended
13 – 22 m	5 – 10 %	15 %	> 15%
>= 23 m	4 – 7 %	10 %	> 10 %

Corners with short curvature can use lower limit, while corners with long curvature (see next page) can use upper limit.

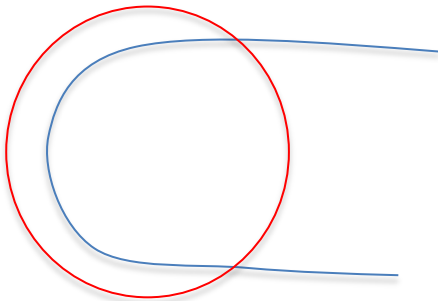
Avoid decreasing radius through the corner (you want opposite)

When «banking» corners also think about if this is suitable for winter-use

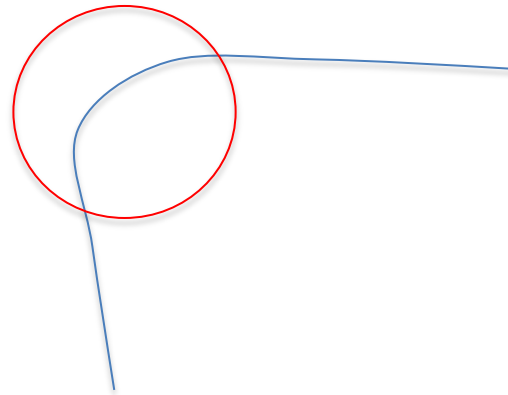
Can verify table by a simple test with a mountain bike (roll through corner without using brakes)

# CURVATURE

Long curvature:



Short curvature:



# DESIGN OF COURSES FOR ROLLERSKIING

## GENERAL

- Parts of a rollerski course should be stripped for technical elements, and be designed for non-competitive and young skiers. This section should be long enough, such that they can be used for easy training, speed sessions, group training, beginners and skiers with disabilities (sit-ski) etc

# Technique training



# Questions?

