Solo Course Design Challenges

2016

presented by

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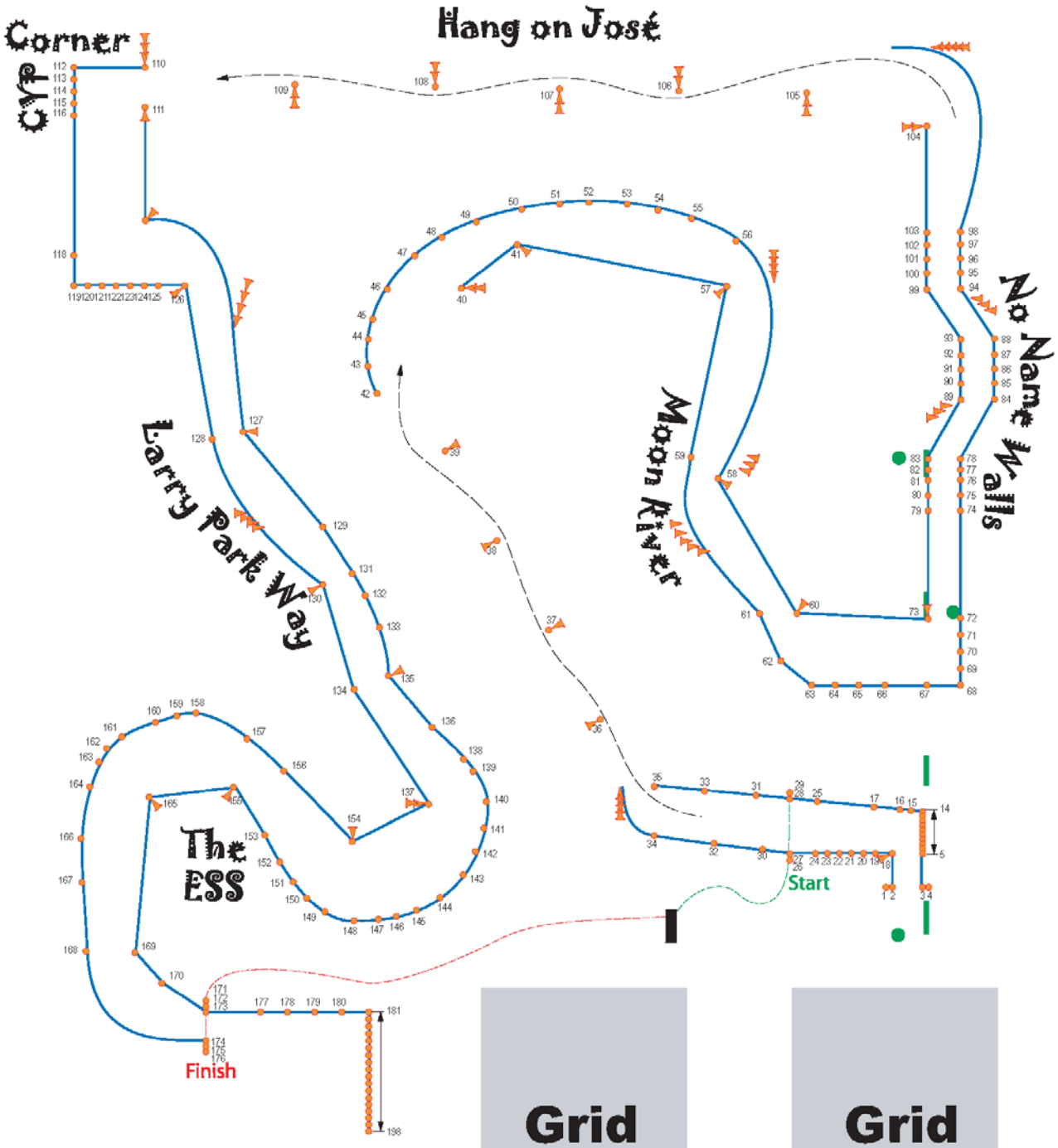
(Roger the Real)

Houston Region SCCA
Sports Car Club of America

Version 5.3


Corner
Cafe
Hang on José
No Name Walls
Moon River
Larry Park Way
The ESS
Start
Finish
Grid A
Grid B

Introduction

- **Credits**
  - This booklet is a plagiarism of the experiences of **Karen Babb, Gregg Lee, Jim Garry, Mark Sirota, Team.Net**, and myself, **Roger H. Johnson** (of no sheep and no yellow ‘Vette)
- **Today’s presentation is broken up into 5 categories**
  - A brief description of each of these categories follows

Agenda

- **Fundamentals**
- **10 Basic Concepts**
- **So you have a Blank Piece of Paper...**
- **Elements, Dimensions and Real Speed**
- **Summary and Questions**

Fundamentals

avoiding all that stuff that can mess up a perfectly good course

- **Make a scale map**
  - Show “known places”
    - Dimensions of parking stalls, and/or Concrete square dimensions
    - Surface Imperfections, Site access points, light poles and curbs
  - Benefits of a scale map include
    - Know where the fast/slow parts of your design are likely to be
    - Know that the finish is safe
    - Hand out maps accurately showing workers their area of responsibility
- **Then place start and finish lines**
  - Establish clear access to the start and from the finish
  - Avoid “drag race” starts to ensure a fair start for all competitors
  - Provide a safe finish
- **Timing and scoring location**
  - Ensure timing crew can easily read car numbers and view the entire course
  - Keep timing equipment and crew clearly out of harms way (i.e. a spinning vehicle)

Fundamentals
(continued)

- **Consider placement of the course workers**
  - Safe workstation positioning
    - Workers do not have to cross one part of the course, nor is the station placed in the path of a predicted spin point
  - Ensure they can See all of the pylons within their responsibility
  - Keep pylons close enough so they can be placed without start delay or a red flag
- **Check out the conditions of the surface**
  - Avoid sections of the pavement that are breaking up or bumpy
  - Avoid patches or treated areas
  - Beware of fluid spills, sticky tar, etc.
  - Avoid drainage grates, manhole covers, or any other non-movable objects
  - Add any unknowns to scale map
- **Allow for multiple cars (site and timing software allowing)**
  - Can two cars (or more) safely be on course at once?
  - Do adjacent section conflicts prevent full use of the time available?

How to Keep Your Solo Peers from Killing You...

…**Get them lost** or make them hit cones!

…**include too many pylons** creating a “Sea of Pylons”

…**space pylons** the same or similar distance as the gate width

…place the next gate **out of their line of sight**

…**fail to line the course** (when possible)

…place a cone(s) thinking “**boy, will THAT one get creamed**!”

Agenda

- Fundamentals
- 10 Basic Concepts
- So you have a Blank Piece of Paper...
- Elements, Dimensions and Real Speed
- Summary and Questions

10 Basic Concepts

1.) Be a Commercial Artist

2.) Use Creativity

3.) No Hidden Agendas

4.) Be Familiar with the Solo Course Design Rules

5.) Make the Course Flow

6.) Use Elements that Favor Horsepower and Elements that Favor Handling

7.) Use Pointers and Directionals Correctly and Sparingly

8.) Line the Course, when possible

9.) Place Gates to Avoid Visual Confusion

10.) Walk/Drive Your Course with the Intent of Improvement

1.) Be a Commercial Artist

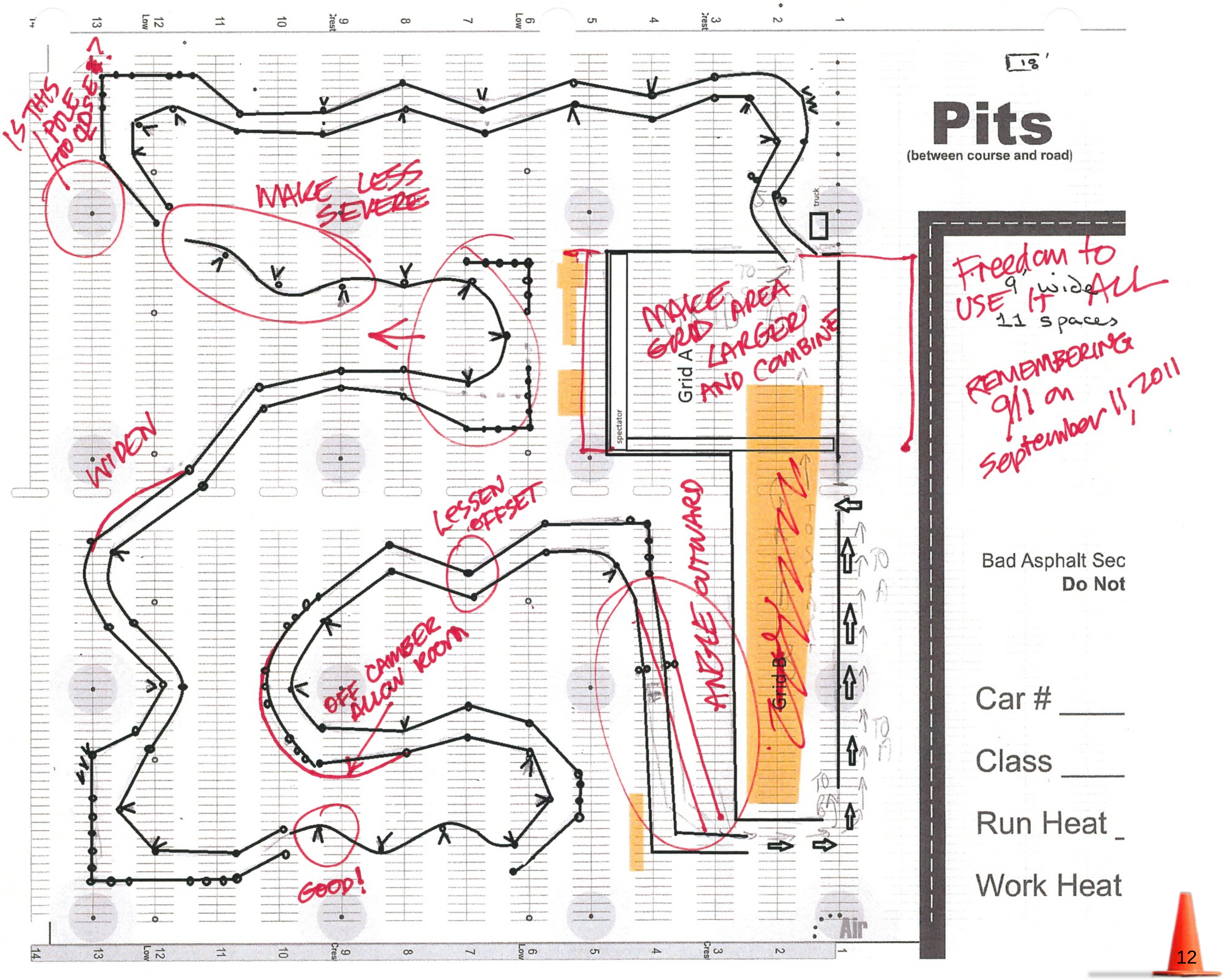
- **As a course designer, you will become an artist; according to Webster, an artist is "one who professes and practices an imaginative art"**
  - Believe me, imagination is required to create a course that is interesting and fun to drive - and when the course design is completed, you will feel like you have created a piece of art!
    - **A Fine Artist is:**
      - An artist whose main goal is to please themselves, and then everyone else can like it or 'stuff it'
    - **A Commercial Artist is:**
      - An artist whose main goal is to please the customer, while pleasing themselves as well

Be a Commercial Artist not a Fine Artist

Set yourself Up for Success

- **The main goal of course design is to provide the competitors with Fair, Fun and Safe Competition**

- **After creating a course design, take copies of it to be reviewed and critiqued by your peers (never destroy the original)**
  - Leave your **pride** at home!
  - **Listen and hear** to what they have to say
  - Ask them to explain the '**hows and whys**' of their suggestion
  - **Mark your map** up with their suggestions and comments



Pits
(between course and road)
IS THIS POLE TOO CLOSE?
MAKE LESS SEVERE
MAKE GRID AREA LARGER AND COMBINE
Grid A
spectator
truck
Freedom to USE ALL 9' wide 11 spaces
REMEMBERING 9/11 on September 11, 2011
WIDEN
LESSEN OFFSET
OFF CAMBER ALLOW ROOM
ANGLE OUTWARD
Grid B
GOOD!
Bad Asphalt Sec
Do Not
Car # ____
Class ____
Run Heat _
Work Heat
Air

Set yourself Up for Success
(continued)

- **After the peer review**
  - **look over and analyze** their comments
  - Address all **safety** related comments
  - **implement** any you feel improve the design
  - Be **true to your basic concept**
    - Put **your own style** into their suggestion; that is why you got the ‘hows and whys’
- **The great thing about “advice” is:**
  - **You don’t have to** take their advice
  - You might **learn or see something** you had not thought about

Judging your Success

(If you're yelling at me, should I assume you didn't like it?)

- **At the event, ask the competitors about your course directly and listen to what they have to say**
  - **What did they like/dislike and why?**
    - **Know why**, so that you can create/avoid that effect again
    - **Listen to their comments** so that you don't become a Fine Artist, who is usually more concerned with their pride than creating a course that everyone likes to drive
    - If your **favorite element is criticized** every time that you use it, it most likely is a poor element; re-think it - don't force your fellow competitors to accept it
  - **Try to 'eaves drop' for comments about the course**
    - This gives you their **"true" feelings** on the matter since they are not concerned with the embarrassment of offending you
  - **Don't get discouraged if some people do not like the course**
    - I have **never** designed a course that **everybody likes**
    - You can usually tell from the '**why**' of their comments as to whether they are **whining or have a valid point**
    - Remember: **those who have won** will love it; **those who have lost** tend not to...

Judging your success
(continued)

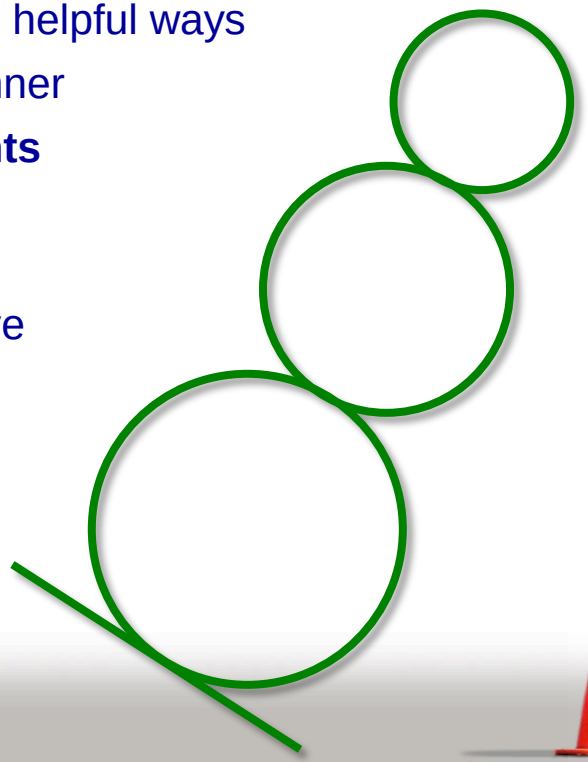
- **Did you receive unsolicited praise or complaints?**
- **Note the number of delays for course workers, course repair, etc.**
- **Track the number of DNFs for other than mechanical failure**
  - The goal is zero - acceptable is **1 in 20** on the first run, **1 in 100** there after
    - The number of "**newbies**" can affect this count
- **Number and frequency of pylons hit**
  - The goal is zero - acceptable is **1 car in 10** hitting any; **less than 4** for any one car
    - If almost every car is **hitting "that cone"**, the course will not be well received

Keep in mind, the main goal of course design is to provide the Solo competitors with

Fair, Fun and Safe Competition

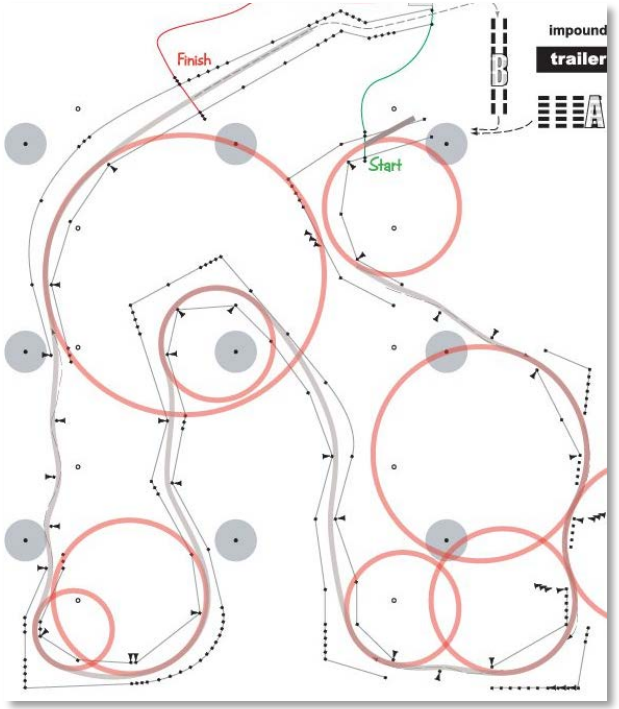
2.) Use Creativity

- **Creativity is what makes a course interesting to drive**
- **What is creativity in course design?**
  - **Rewarding** those with the right amount of **skill, aggression, experience** and **discipline**
  - Placing **challenge** in the design without making it "**painful**" or too much **input density**
  - Using **chalk lines** in a variety of visually interesting and helpful ways
  - Setting up an **often used maneuver** in a **different** manner
  - Including a **variety** of different **turn-types** and **transients**
- **Be creative and innovative but avoid the bizarre**
  - When you come up with a **new concept** that you believe to be new and creative, take a moment to analyze it
    - Is it so creative that it has become **bizarre**?
      - If so, modify the idea or forget it, because it will not be well received by most drivers



Application of Creativity

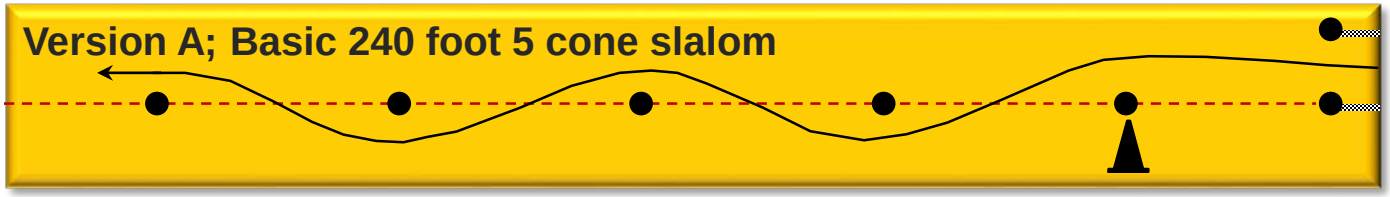
- **Include turns of varying radii and speed**
  - **Sweepers** should come in **various sizes**, possibly even with **changing radii**
  - Don't design a course consisting primarily of 180° turns
    - use 90°, 180°, 60°, fast 45° turns, etc.
- **Provide a variety of car path directions**
  - Use the various turns to send the car in directions **not always perpendicular** or **parallel** to the site outside perimeter or the site markings on the surface such as paint stripes or concrete squares
- **Provide a variety of transients**
  - Straight slaloms / offset slaloms
  - Sequences of offset gates
  - Lane changes
  - Combinations of the above
    - Challenging courses include **combinations of transients** that require a **precise entry** into the first part of the combination in order to drive through the entire combination quickly



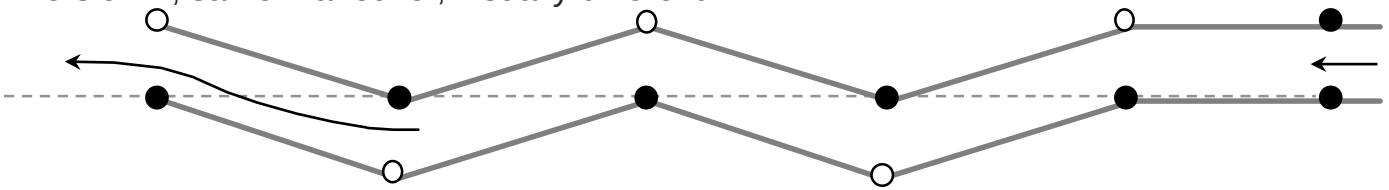
Input Density

- **Input density is:**
  - Measure of direction-changing steering inputs, divided by the length of the course
    - The following is only a guideline (nothing is “black and white”)
- **Desired input density is about 20 to 35 inputs over a distance of ~ 3/4 mile**
  - Adequate time to set up between maneuvers, challenging to drive fast, drive times vary, drivers do not have trouble remembering all elements
- **A less interesting course will have only 15 to 20 inputs for ~3/4 mile**
  - Too much time between maneuvers, resulting in a boring, non-challenging, course to drive where all times are approximately the same
- **A “too busy” design will have more than 35 inputs for ~3/4 mile**
  - Drivers will never seem to have the time or room to set up for the next element
  - Drivers feel they are thrashing through the course, just trying to survive until the finish

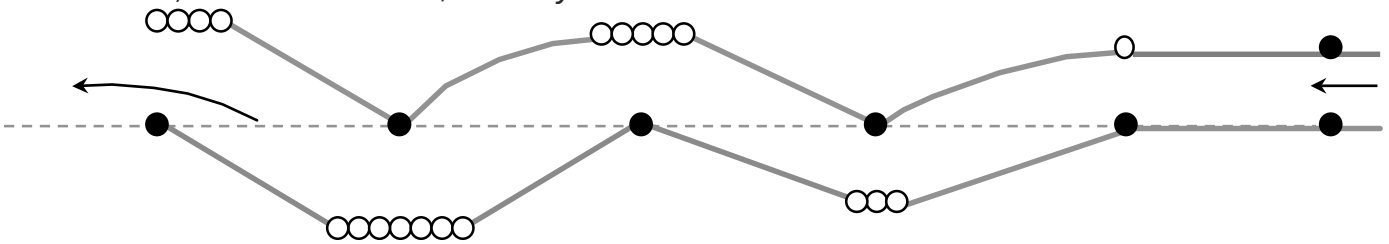
5 Cone Slalom



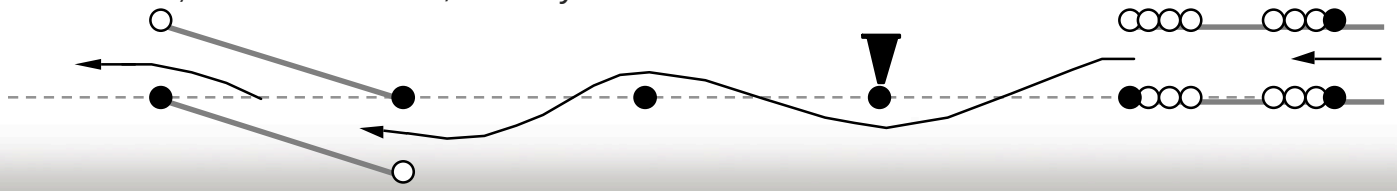
Version B; same maneuver, visually different



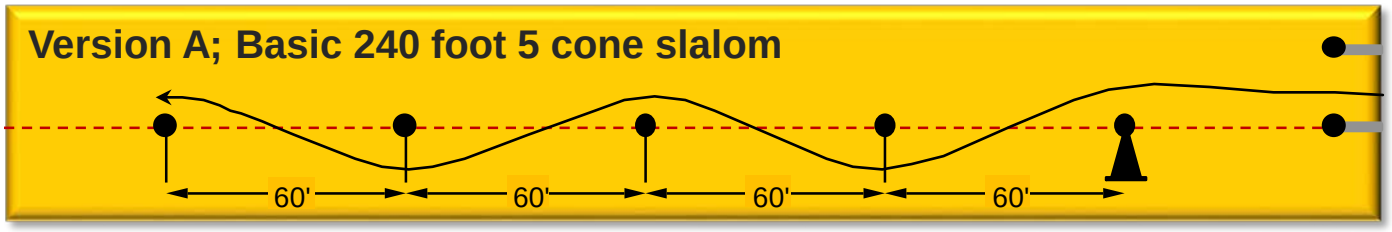
Version C; same maneuver, visually different

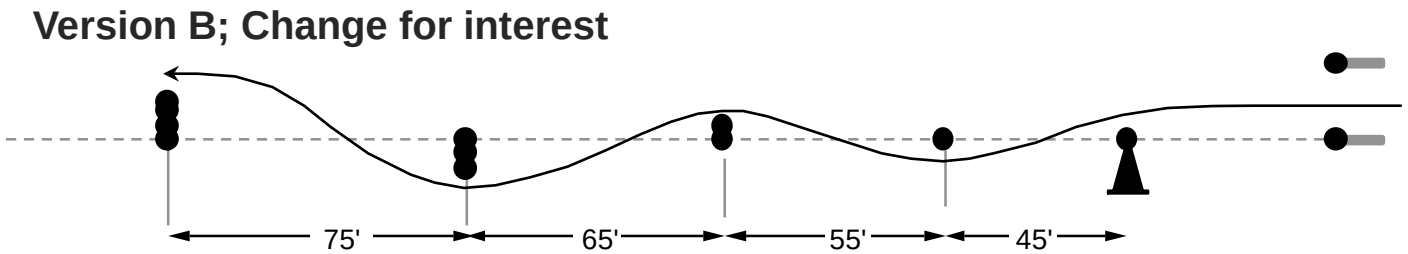


Version D; same maneuver, visually different

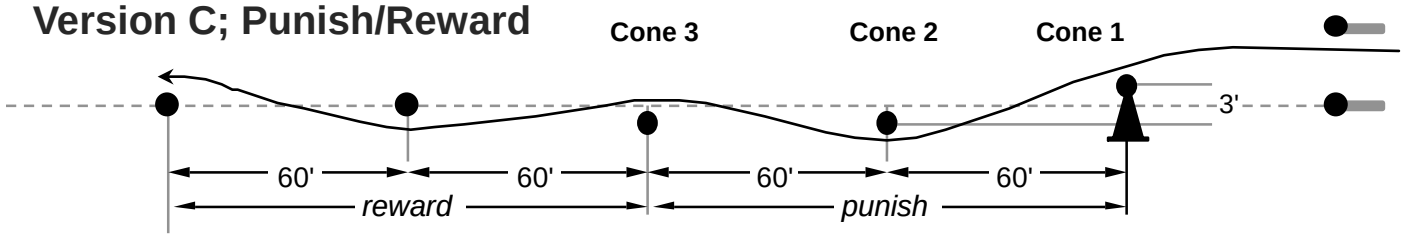


5 Cone Slalom
(continued)





Note: Version A & B are both 240' long. Version B offsets one cone width for each gain of 10' in slalom length, resulting in a more interesting maneuver of the same nature. The increase in distance prevents the maneuver from becoming painful

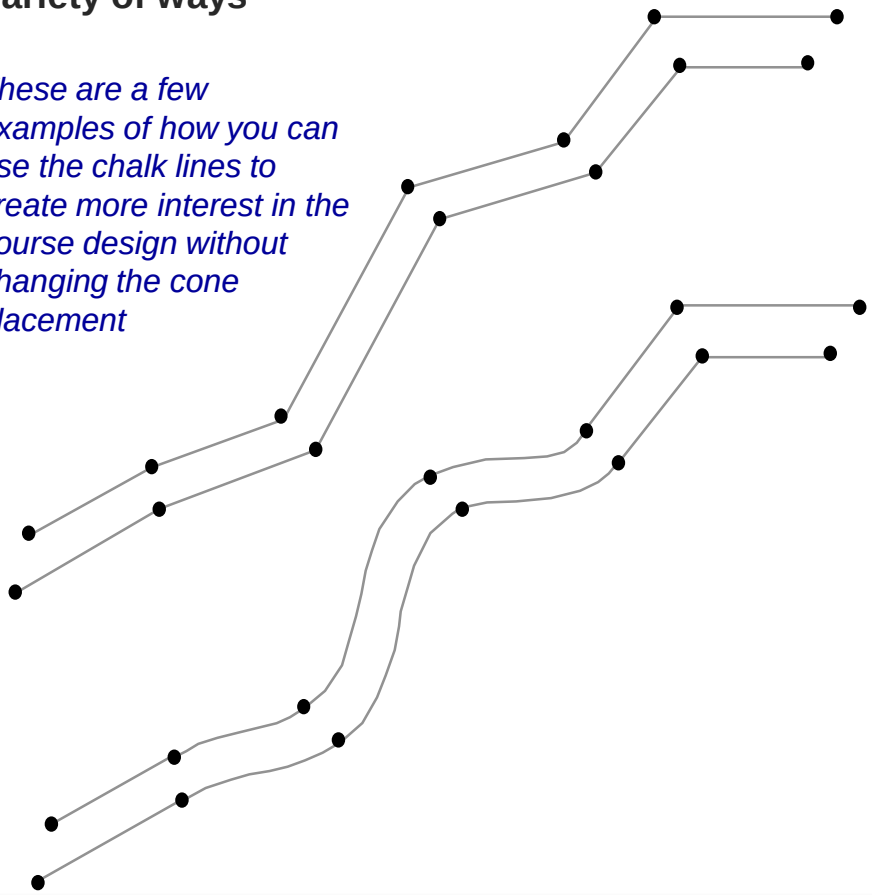


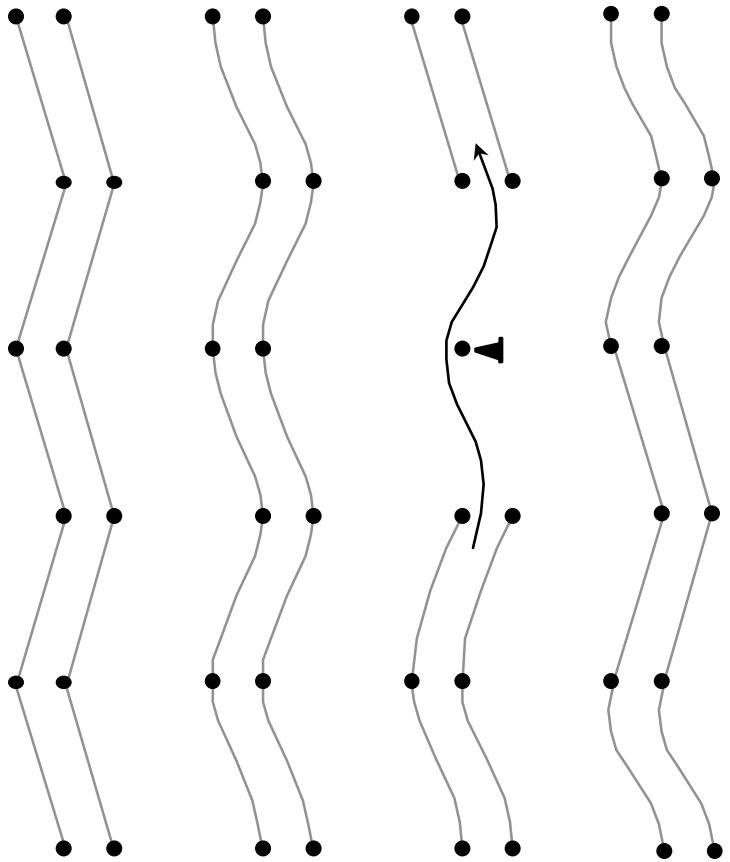
Note: Cones 1 & 2 are offset 3' the hard way with cone 3 offset 1.5' the easy way. This opens up a "Lotus freeway" through the last 3 cones of the slalom. To make the punishment bearable, be sure to allow adequate set up area prior to the punishment, otherwise the punishment becomes painful

Chalk Lines

Use the chalk lines in variety of ways

These are a few examples of how you can use the chalk lines to create more interest in the course design without changing the cone placement



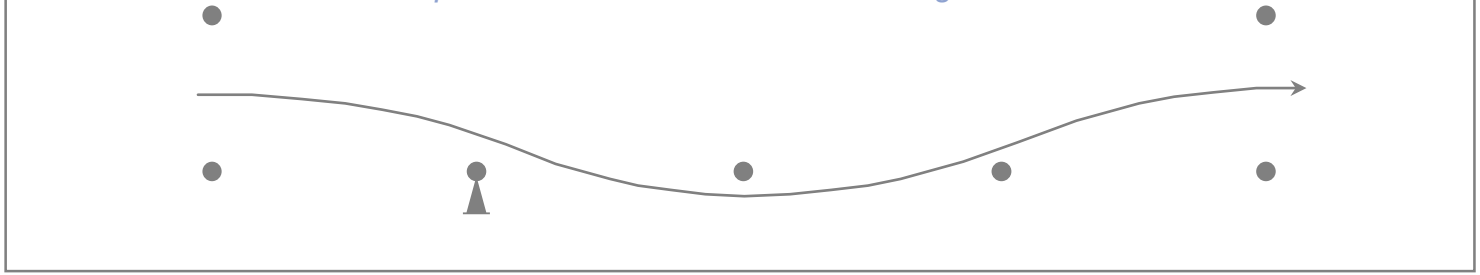


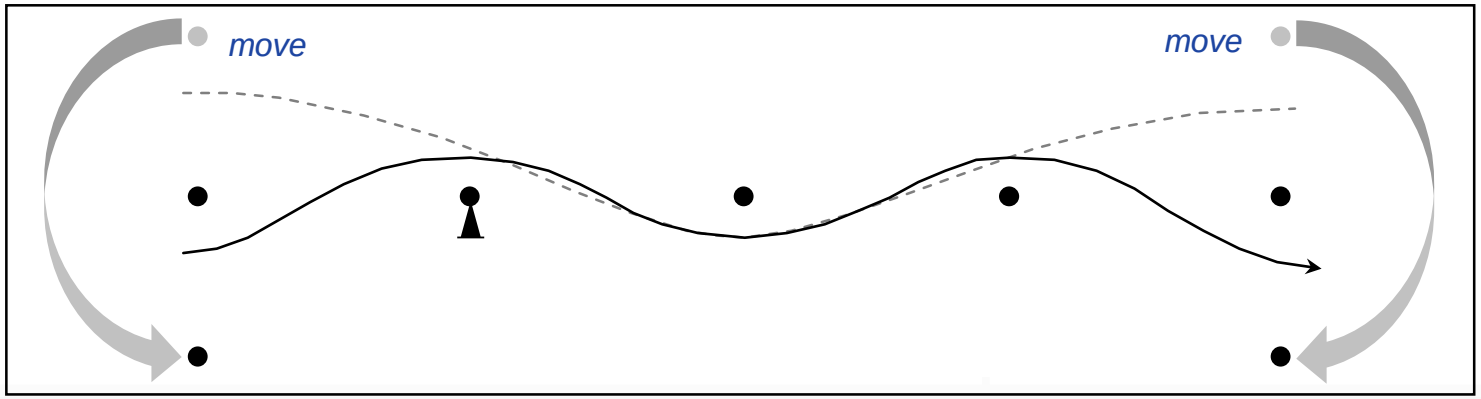
The “Before and Afters”

Placement of the gate “before and after” the start and finish of a slalom is critical as to the amount of turns that the slalom actually becomes

3 Cone Slalom

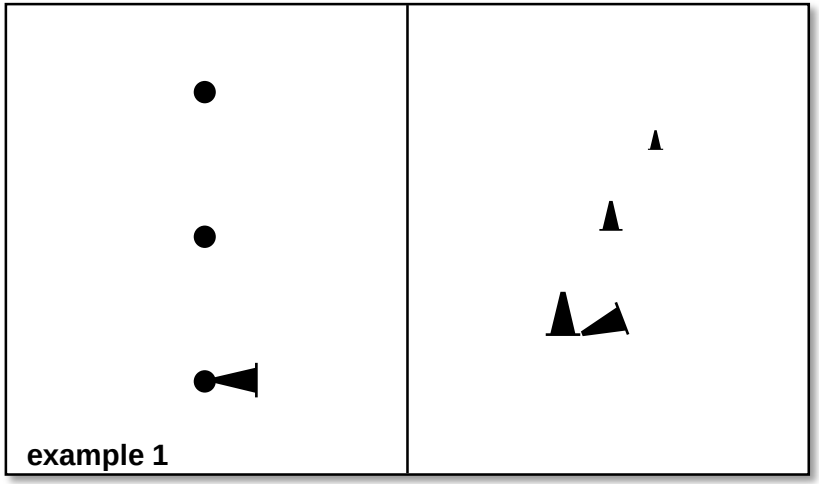
The intent of a three cone slalom is usually to make 3 turns. As you can see from this example, this slalom has become 1 turn due to the placement of the “before and after” gates

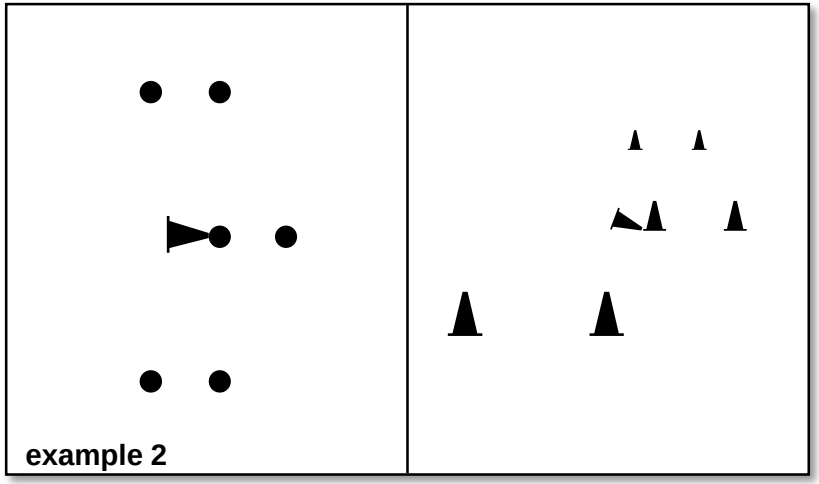


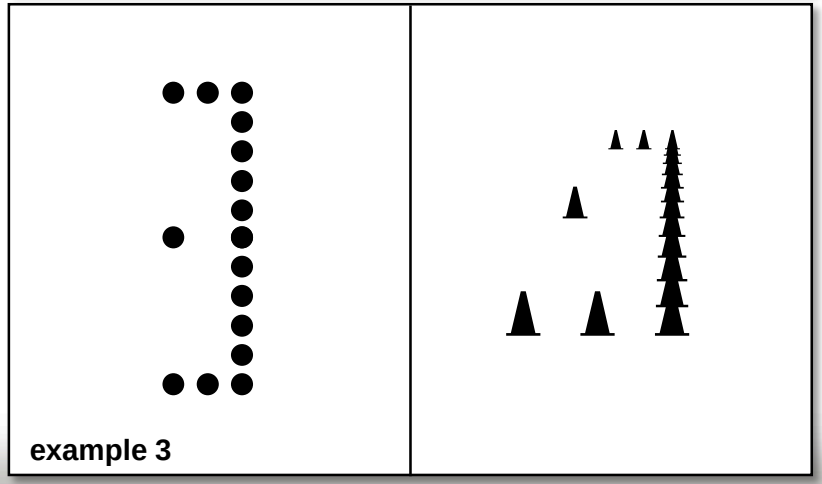


Which is easiest to See?

All three of these are a slalom - the same maneuver; **Example 1** will be the easiest to see







You must also consider if the inclusion of your **"creative" cone placement** has **reduced clarity** of the course significantly

The surrounding cones from the following maneuvers may impact the clarity of these examples as well

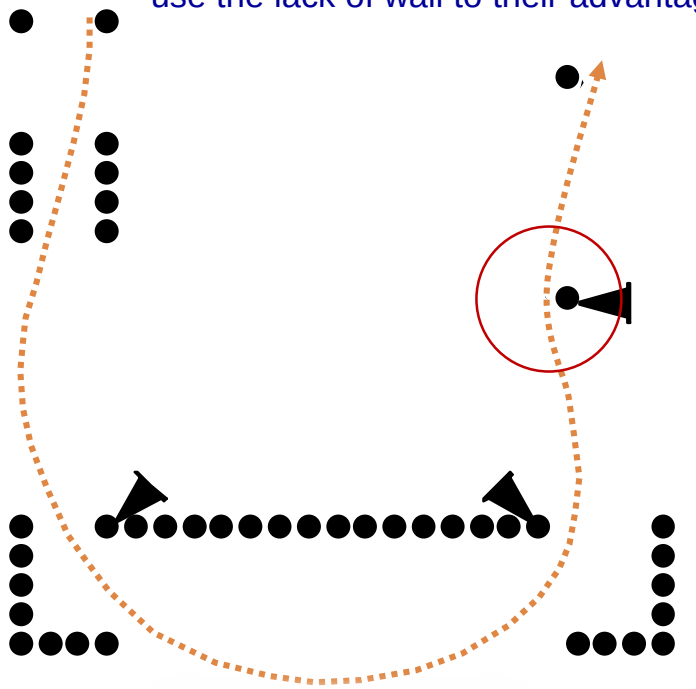
For instance, if you have several walls of cones following this slalom, example 1 would be most appropriate; and if not, examples 2 or 3 might be more appropriate

The Brainer

the intent of a "brainer" is to allow a fast line through, but give it the visual effect of a slow maneuver. This will then give the competitor a reward, or a "doggy bone" if you prefer, for figuring it out.

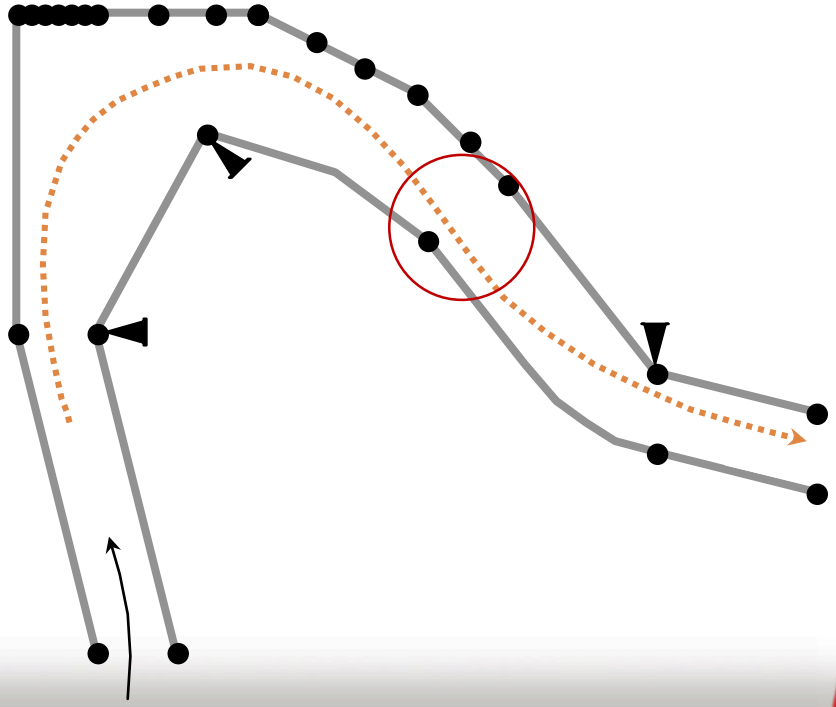
The Brainer

The wall at the 180º will tend to make an unwary competitor square the corner out. The driver who looks carefully will round the corner out and use the lack of wall to their advantage



The Brainer

Competitors that don't "read" the course tend to drive cone to cone. The indicated cone will tend to pull in a driver who has not thought this one out. The fast line is to stay wide to make a sweeping turn.



3.) No Hidden Agendas

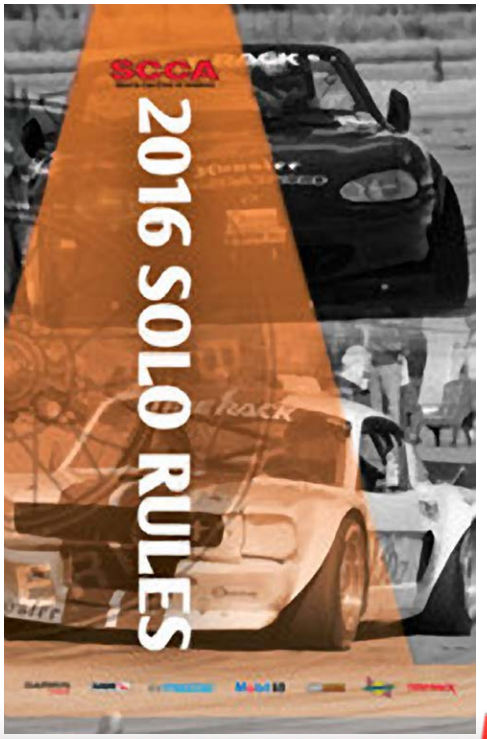
- **You should not accept a course design job for any reason other than a desire to design a course**
  - If you are not **really interested in the design of it**, chances are that you will not create a good course
  - If you have gotten the responsibility '**by default**' (i.e the Event Chairman):
    - Enlist someone who is **truly interested** in designing a course
      - you will still be responsible for the design, but will have "jobbed" it to a more qualified/interested party
  - Avoid designing the course on the premise of **favoring your car**, while penalizing others
    - Example; Camaro versus Miata
      - Camaro: 1000' straight, 180° turn, and a 1000' straight
      - Miata: 45' offset slaloms connected with 30' radius "sweepers"

With a hidden agenda the result is a course that only a few people enjoy - or perhaps even a course that **NO ONE** will enjoy!

4.) Be Familiar with the Solo Course Design Rules

Basic Concept 4.) refers to the rules found in Section 2.0 of your Solo rule book

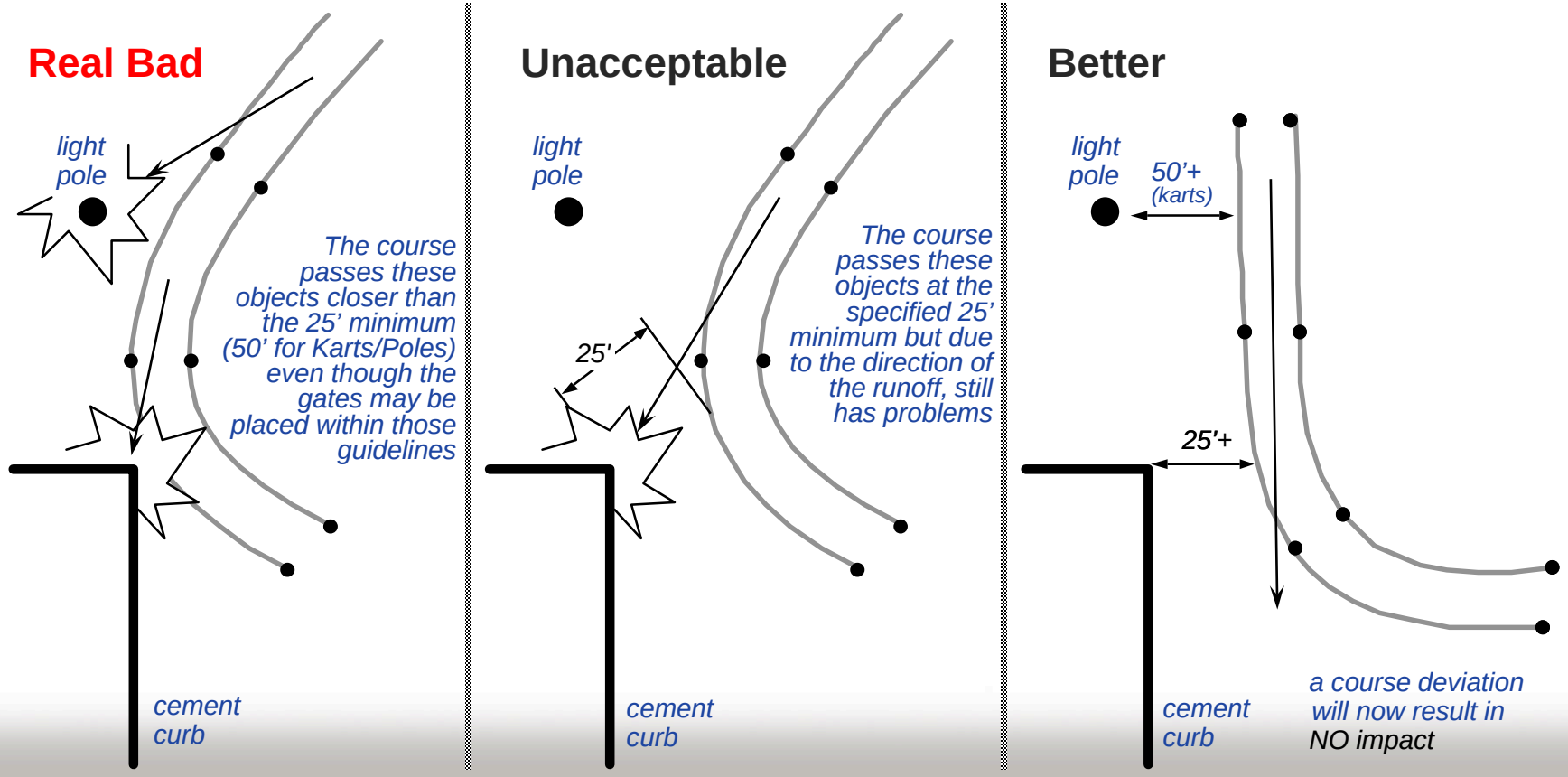
- **By knowing the rules in Section 2.0, you will be able to create a design that will be a Solo type course, as well as a design that is acceptable to the Solo Safety Stewards and your peers**
- **The following are diagrams taken from some of the 2016 rules**
  - ALL of the rules, of course, are important and should be known/understood - these are just the rules that I perceive to have the most impact on your design decisions



2.0 Diagrams

2.2.C The course boundary shall not normally pass closer than **25 feet** from solid objects
2.2.D **karts**… ...upright solid objects on site within **50 feet** of the course.
This does not include curbs

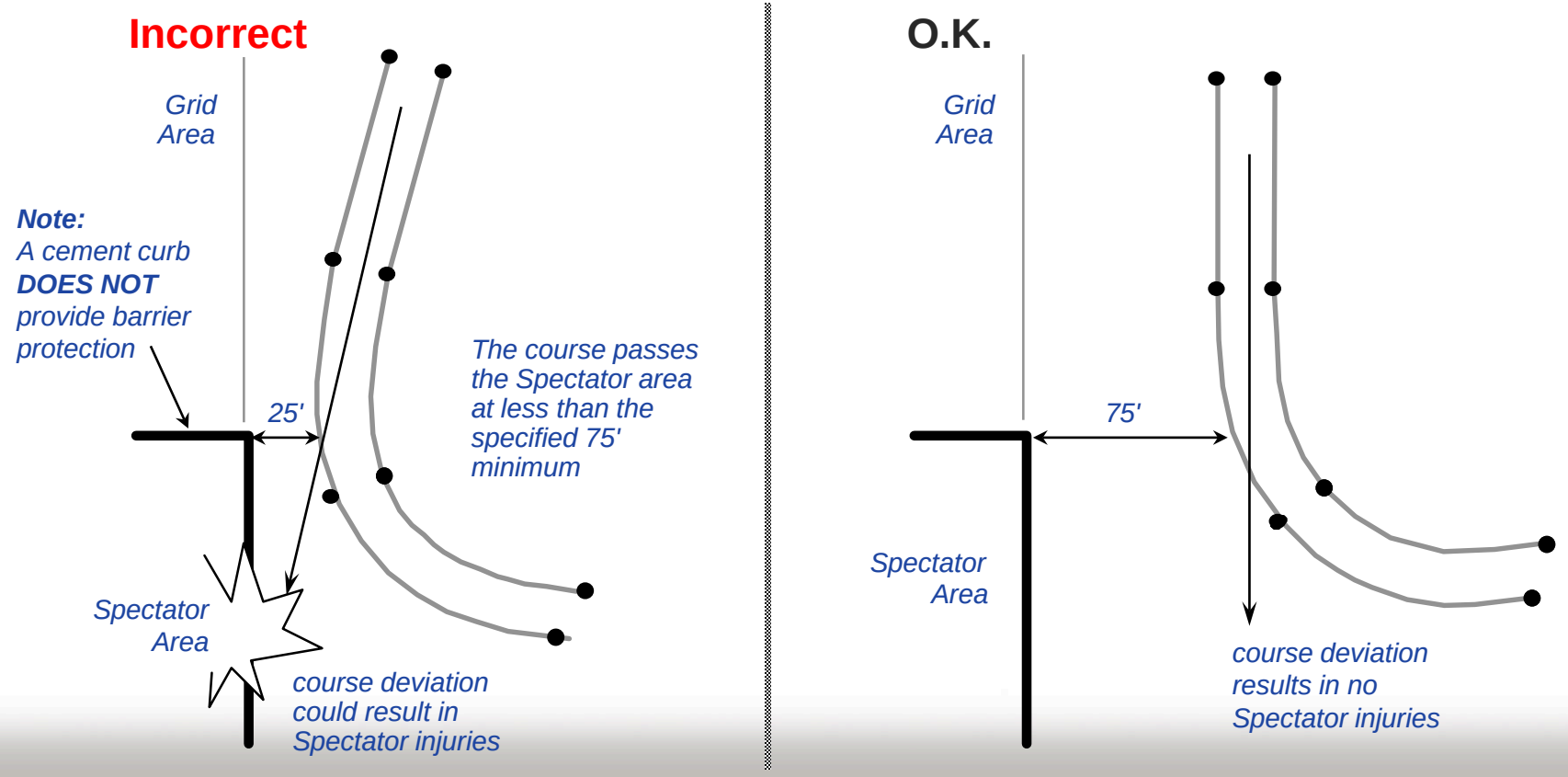
The "better" example shown here is considered minimum. Greater distances from Stationary objects is always better



2.0 Diagrams
(continued)

2.2.M Participants and non-participants must be kept at a safe distance... ...minimum viewing distances may not be less than **75' from the course edge in unprotected areas** (areas without adequate barrier protection such as concrete or tire walls)...

The preferred example shown here is considered minimum. Greater distances from Spectator Areas are always better. Fast course sections should never aim directly at spectator areas without very large runoff distances

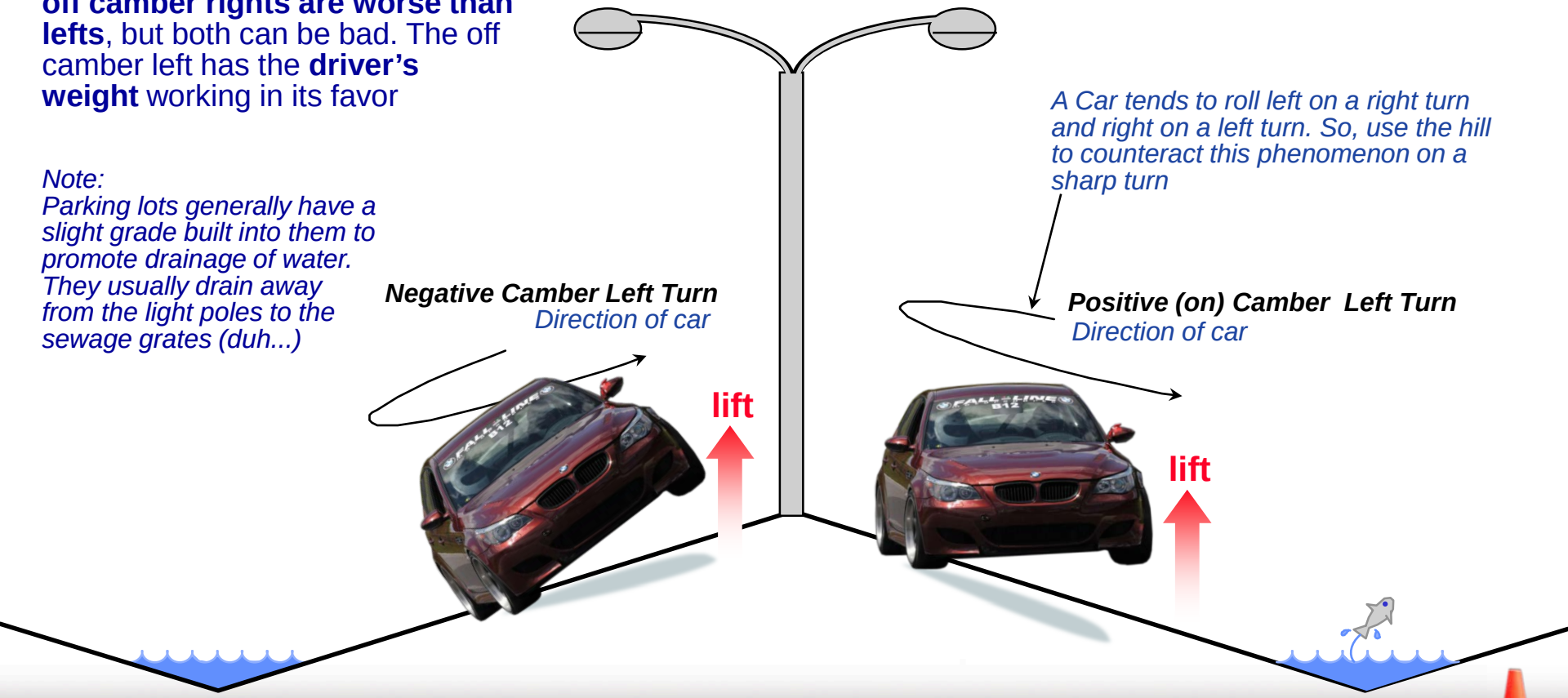


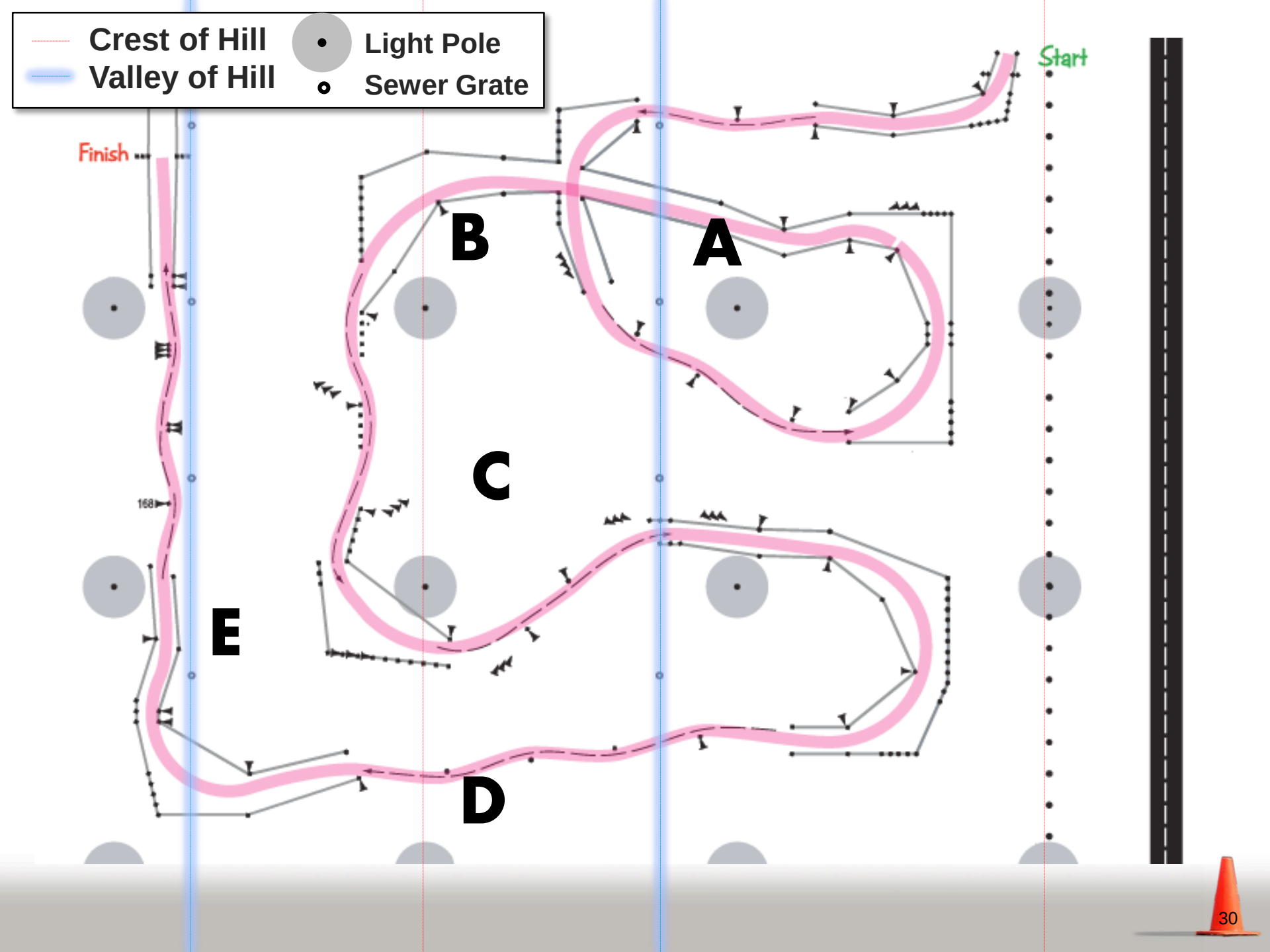
2.0 Diagrams
(continued)

2.2.E Special caution should be applied where negative-cambered turns are used.

Note:
off camber rights are worse than lefts, but both can be bad. The off camber left has the **driver's weight** working in its favor

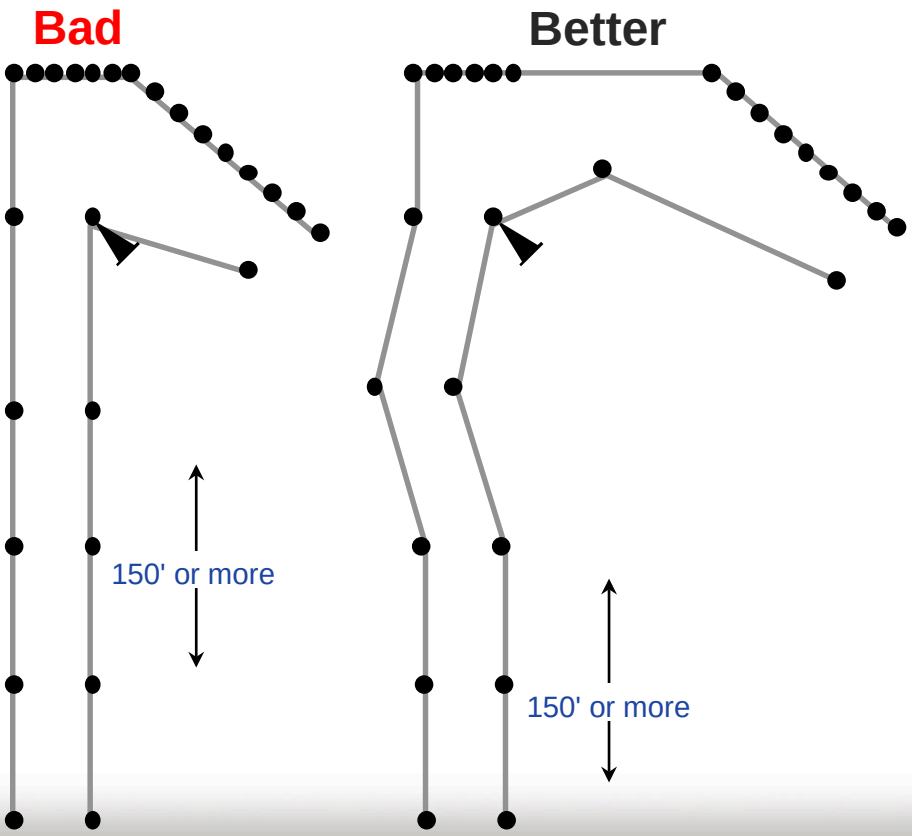
Note:
Parking lots generally have a slight grade built into them to promote drainage of water. They usually drain away from the light poles to the sewage grates (duh...)

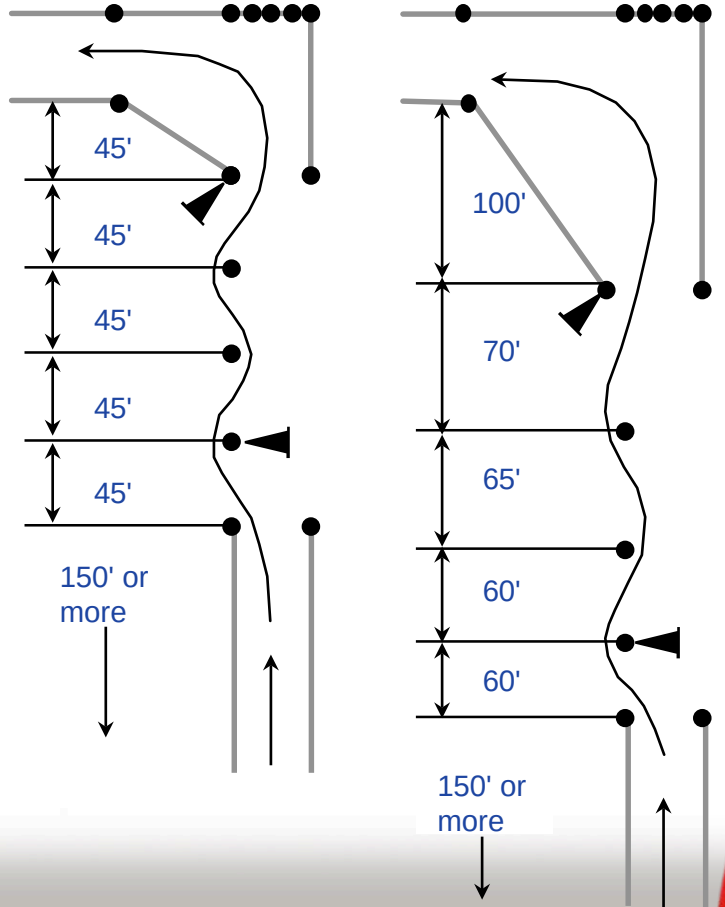



Crest of Hill
Valley of Hill
Light Pole
Sewer Grate
Start
Finish
A
B
C
D
E
168

2.0 Diagrams
(continued)

2.2.F A long straight (over 150') should not terminate in an extremely sharp turn...



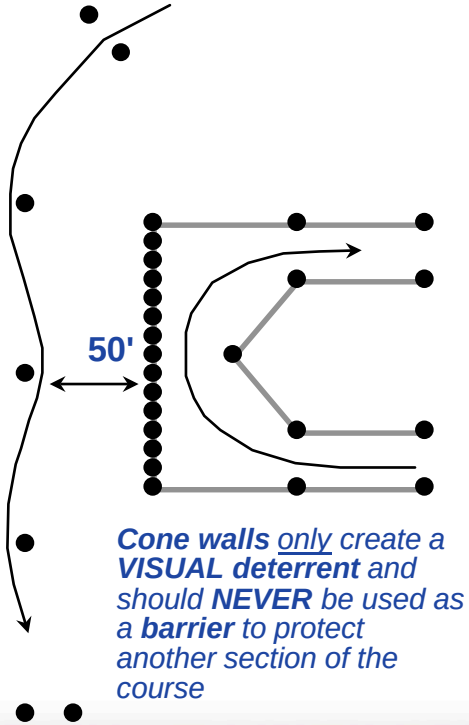


2.0 Diagrams
(continued)

2.2.H Cars on course simultaneously shall not run in close proximity to each other

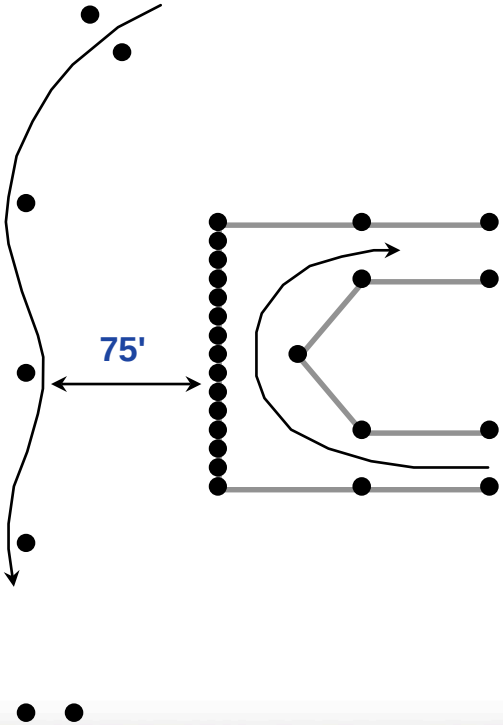
"**Close Proximity**"... The definition of this is ultimately up to the **Safety Steward**, but if you consider rule 2.2.L, the absolute minimum would be **75'**. Obviously, the more drastic the maneuver, the more space that should be allotted. The whole idea of this rule is to keep 2 competitors from colliding in the event of one (or both) of them losing control or getting lost on course.

Unacceptable

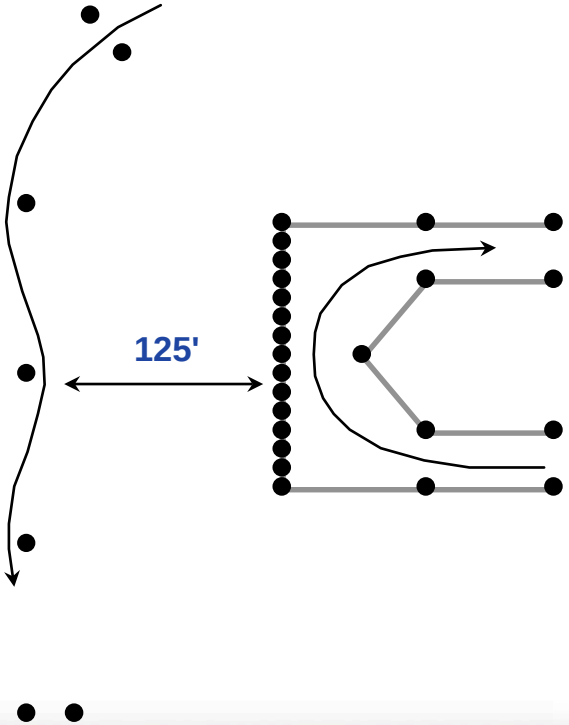


***Cone walls** only create a **VISUAL deterrent** and should **NEVER** be used as a **barrier** to protect another section of the course*

Acceptable



Better Yet



5.) Make the Course Flow

"There's no such thing as a car that can turn on a dime..." *K.C. Babb*

- **It's not necessary to get into third gear in order to have a fun course**
  - The level of "fun" will more likely be **determined by the flow of the course** instead of the highest attained speed
  - If you **feel like you've gone fast** without violating the speed paradigms, then your design is a success
- **So, then what is the "Flow of the Course"?**
  - The flow refers to the way **adjacent sections** of a course connect to each other

5.) Make the Course Flow

- Envision a river flowing down a riverbed
  - **Even when the water is moving rapidly and encounters an object, it will find a way to flow around the object smoothly**

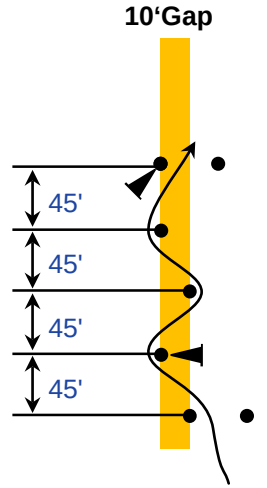
Your course should have the same characteristics - If a car cannot be maneuvered through the obstacles smoothly, the course does not flow

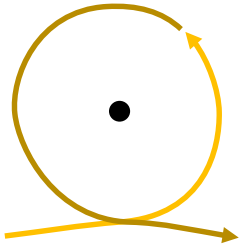
Ways to Make Your Course Flow

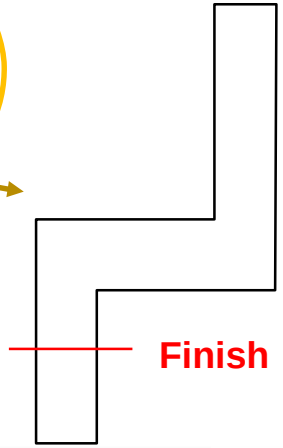
- **To be able to accurately determine the flow of a course before you set it up, you must be able to first draw a scale map (gasp!)**
  - **Visit the site before** submittal of your map to make your map accurate and to include things and land formations to avoid
- **Locate the "key cones" in your design**
  - Determine which cones control the speed and direction of the course (key cones) and **remove** any of the remaining cones that could cause confusion
- **Remove a slalom cone in a 45' - 55' slalom**
- **Allow a few more feet of width and/or length when approaching the next maneuver**
- **Avoid painful walled-in turns**
- **Ensure the "next gate" is visible in your peripheral line of sight**
- **Move a limiting or constricting gate 1 to 10 feet left or right to open the approach up**
- **Do not use painful maneuvers to slow things down**

Maneuvers to Avoid

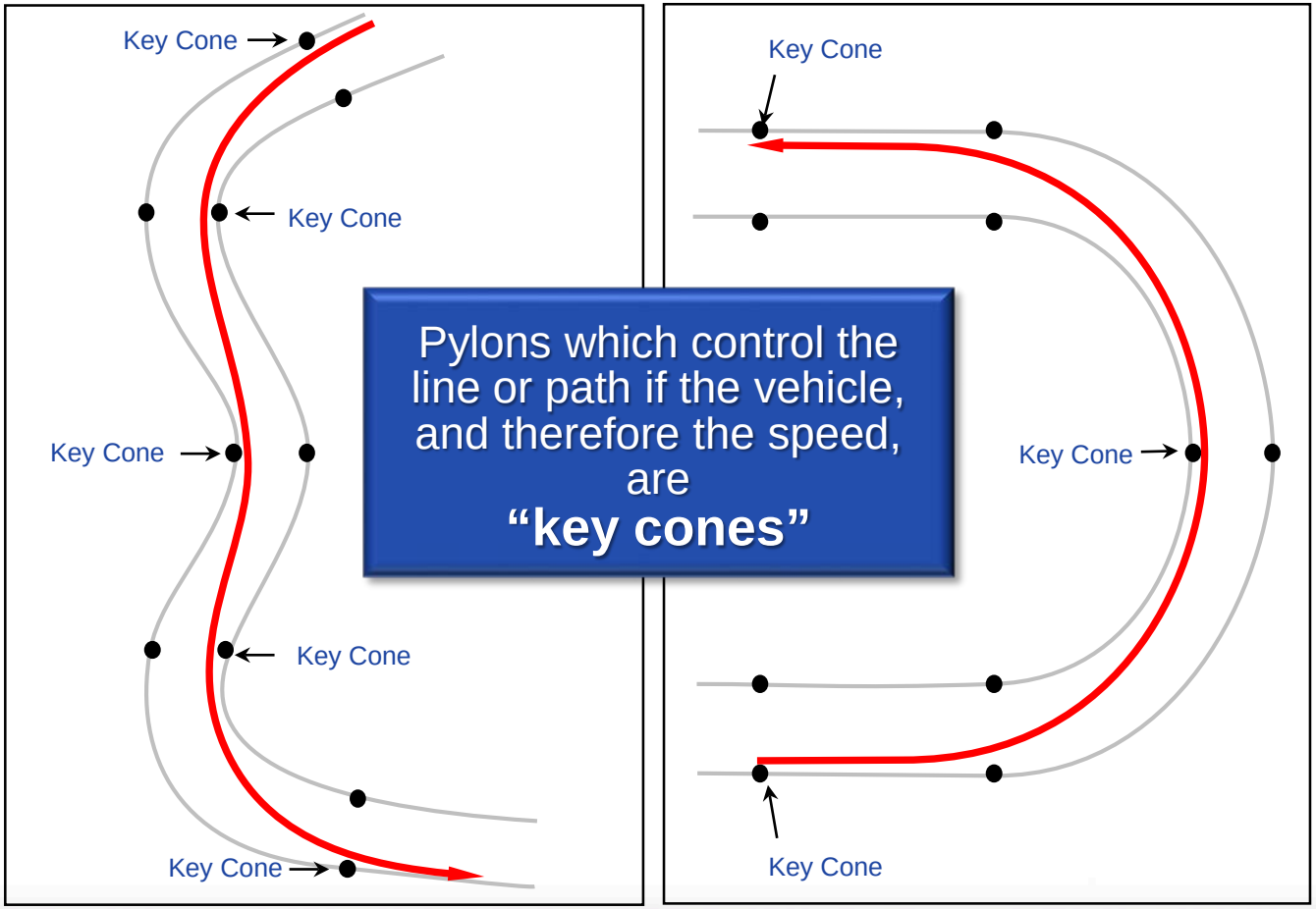
- **Avoid maneuvers that could make a car roll**
  - Don't use significantly **off camber turns**, especially right turns
  - Don't use **decreasing radius right turns** - especially sharp ones
  - Avoid "**one-two**" hard corrections following a fast section as can can be found in a decreasing slalom
- **There are also a few "No Fun Maneuvers" (NFMs) that I would recommend avoiding if possible**
  - Any maneuver that **requires** a **1st gear** down shift
  - **360 degree pivot turns** - or also known as a spin cone
  - **Narrow**, walled in sharp turns
  - Gates or Slaloms with **severe offsets** and **short spacing** (45' spacing; 10' offset)
  - Two **90 degree walled in turns** (shaped like a "Z") just before the finish lights, which is O.K. for a start - but no way to finish!
  - **Hitting the brakes** hard just before the lights



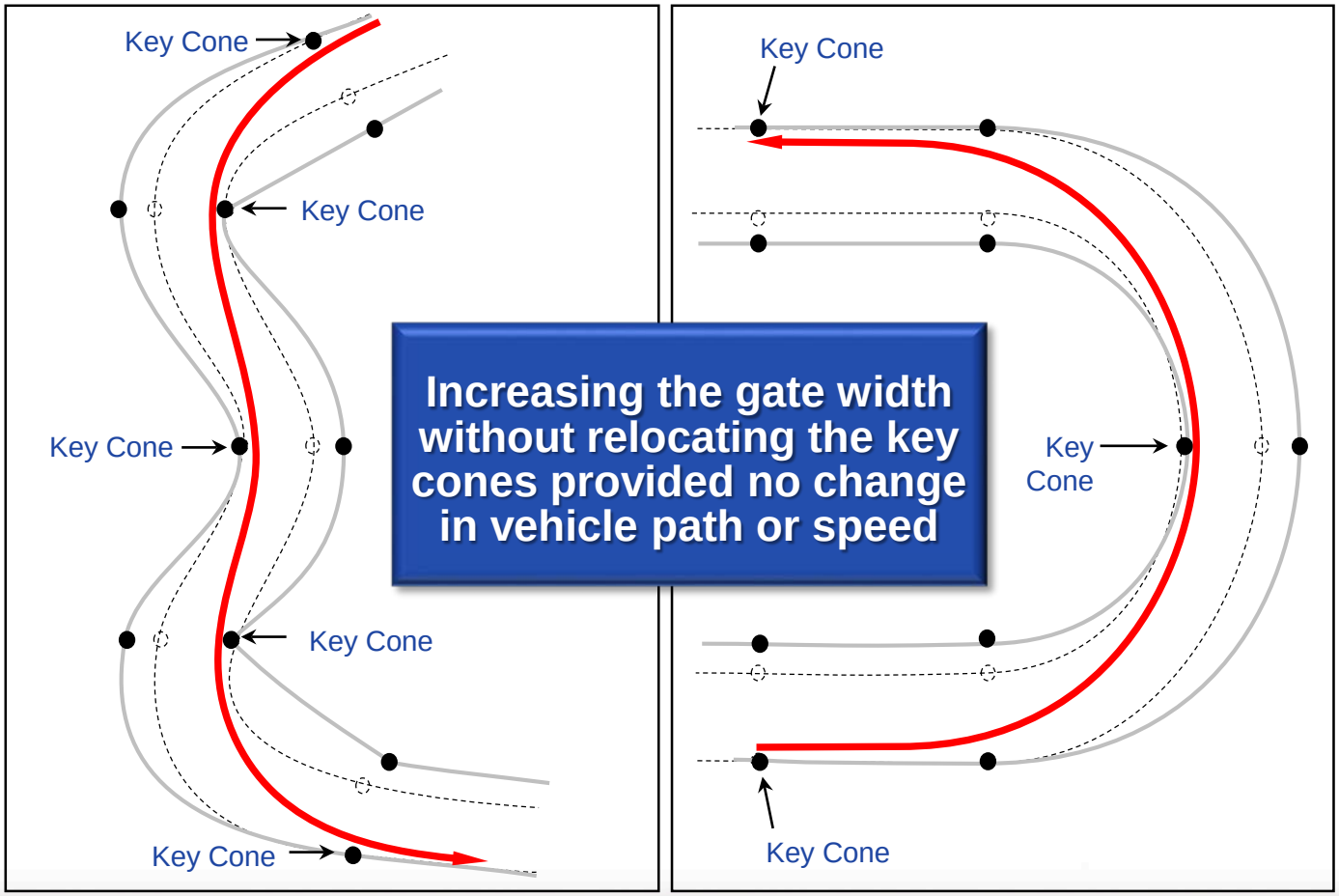




Locating Key Cones



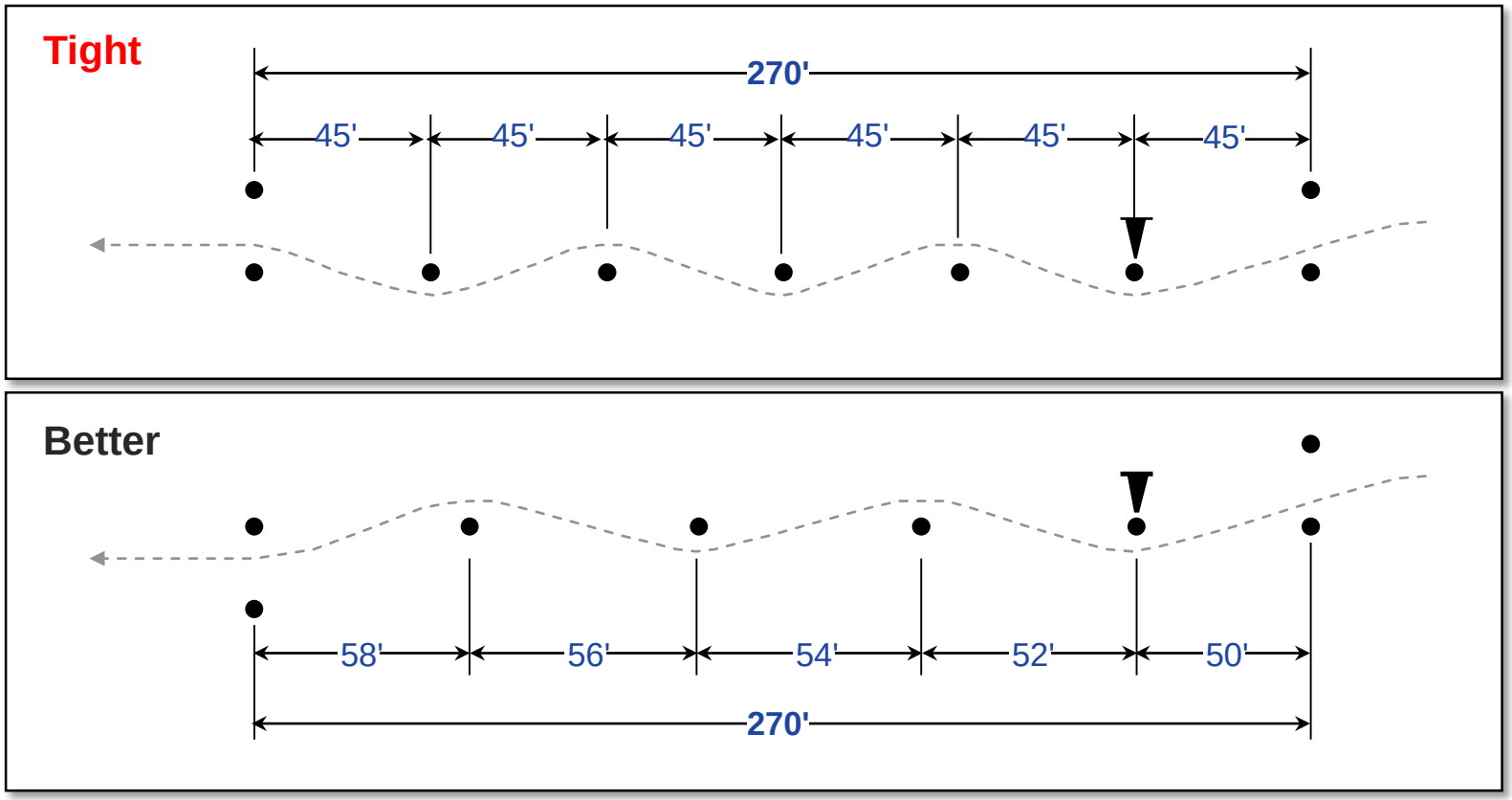
Gate Width versus Speed



Advantages of wider gates

- Choosing the **superior line** requires more skill and experience
- **Allows** for mistakes/sloppiness with **no pylon** penalties
- **Easier** on course **workers** and timing & scoring

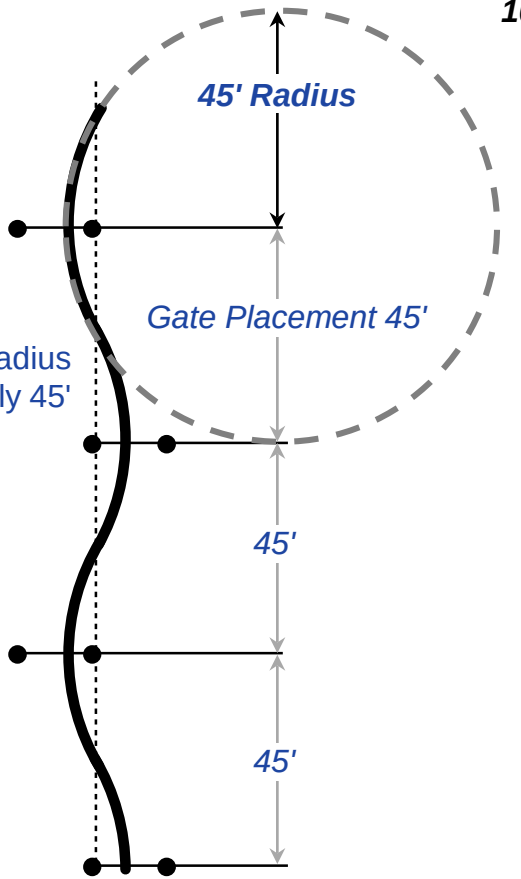
Remove a Slalom Cone



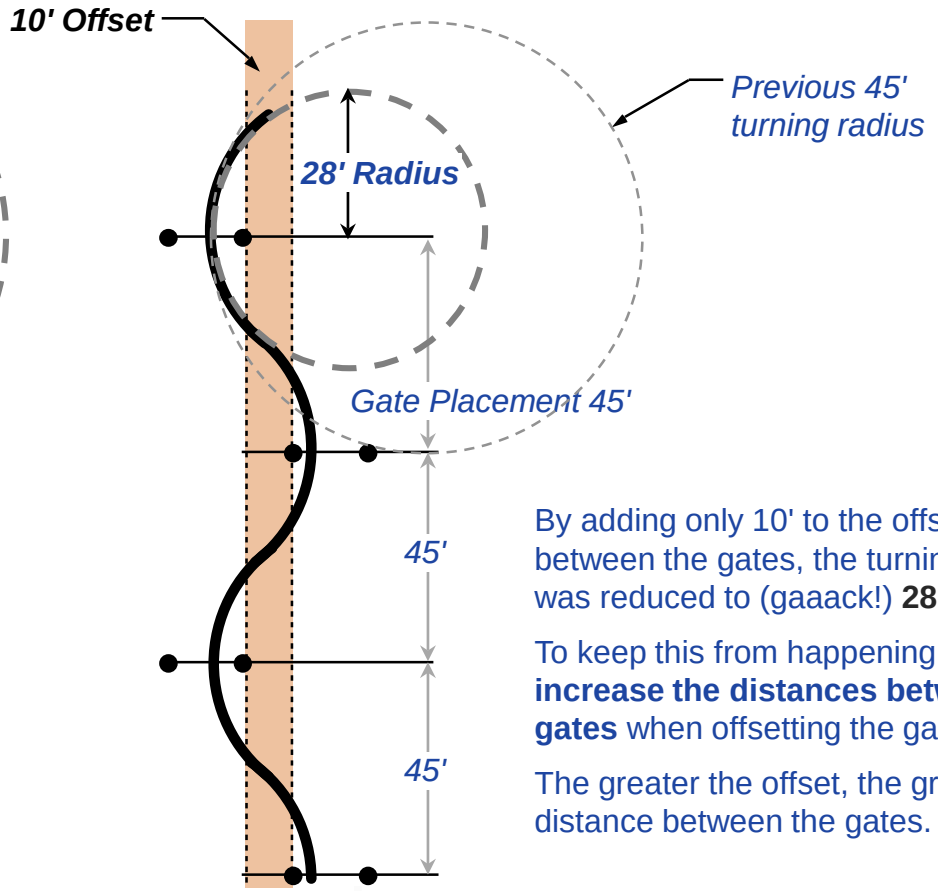
- By **removing** only **one cone** in this 270 foot slalom, you are able to open up the slalom to a more reasonable spacing of 54 feet. This is not a “wide open” slalom and definitely flows better than the example on top. You can also make the slalom a **gradually increasing** allowing the more astute course walkers the chance to pick up on a feature that not everyone will realize

Lock to Lock Turns

No lock to lock turns



the resulting turning radius is approximately 45'



By adding only 10' to the offset between the gates, the turning radius was reduced to (gaaack!) **28 feet!**

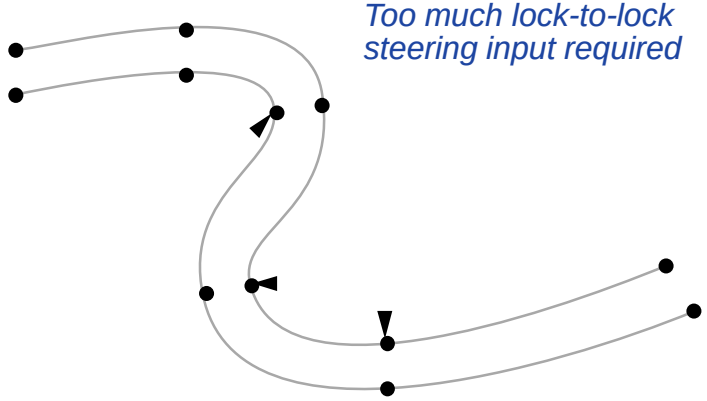
To keep this from happening, **increase the distances between the gates** when offsetting the gates.

The greater the offset, the greater the distance between the gates.

Lock to Lock Turns
(continued)

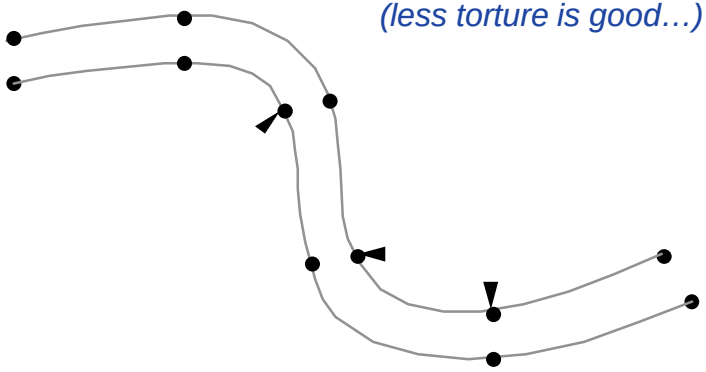
not fun

Too much lock-to-lock steering input required



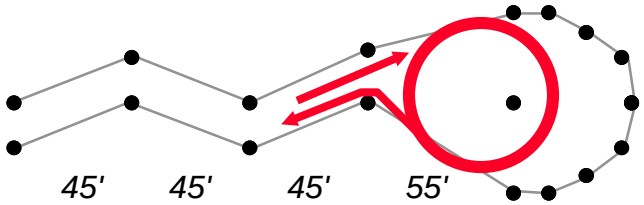
better

Same driving skills tested with less torture (less torture is good…)



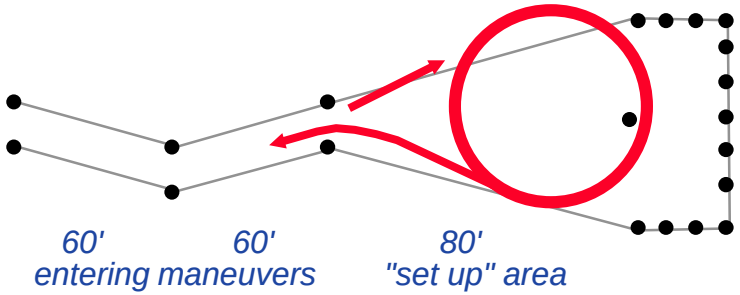
painful

Generally, avoid 180° turns. If required by lot shape, don't make lock to lock steering inputs just before entering the 180



better

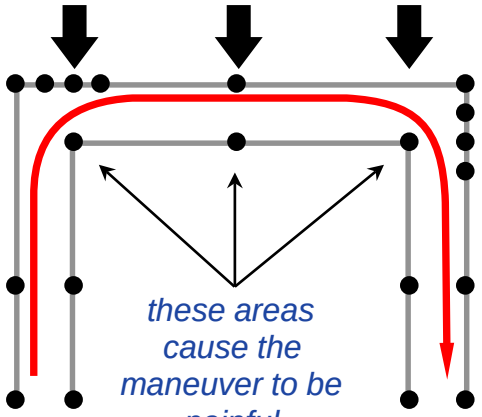
- *Open up the entering maneuvers*
- ***Allow plenty of setup area** to enter/exit a 180° turn*



Avoid "Painful" Walled in Turns

Painful

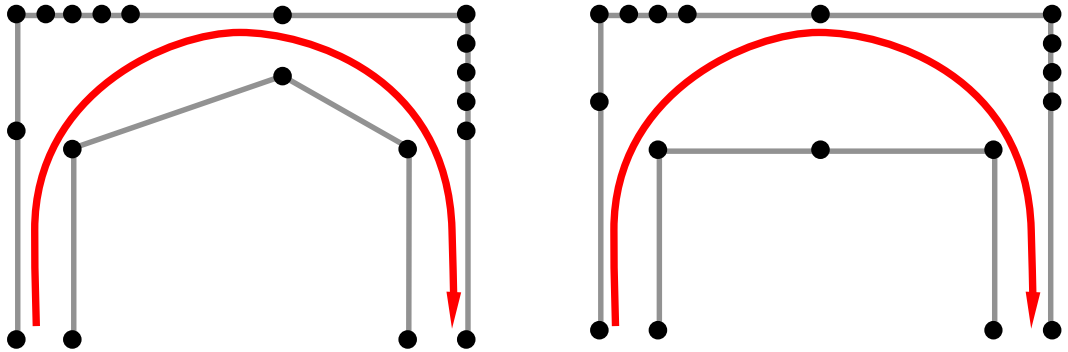
Narrow, walled in sharp turns



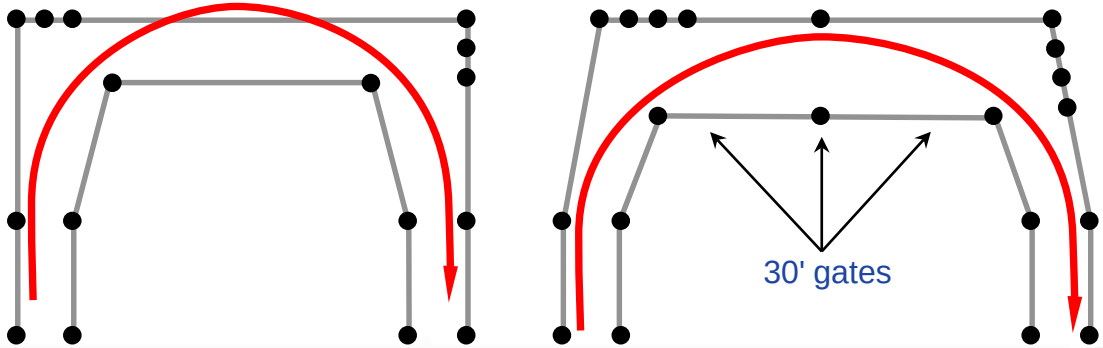
The placement of the wall forces the turn to be made up of **2 or more painful turns** instead of a flowing turn

Better

solutions keeping the same flavor as the original

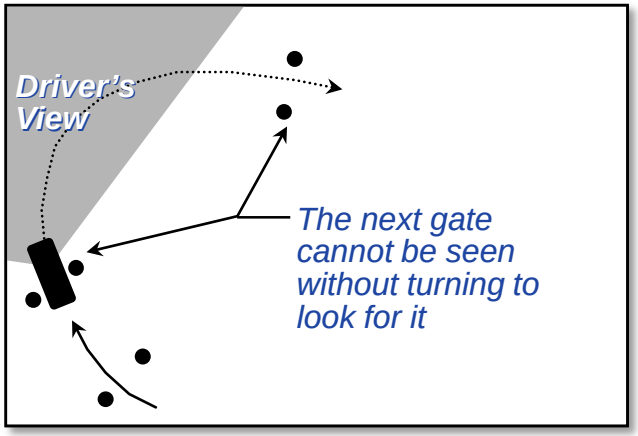


1 flowing turn…

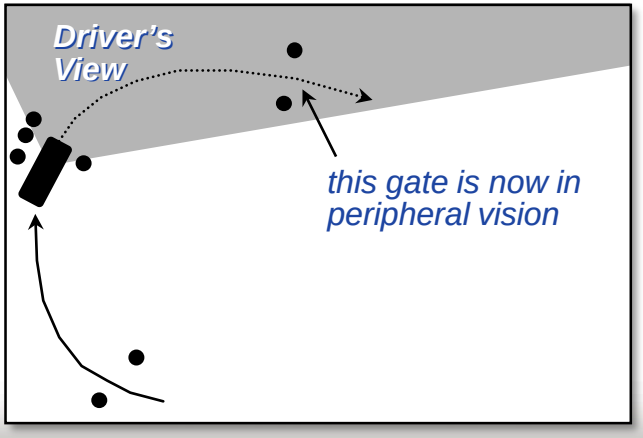


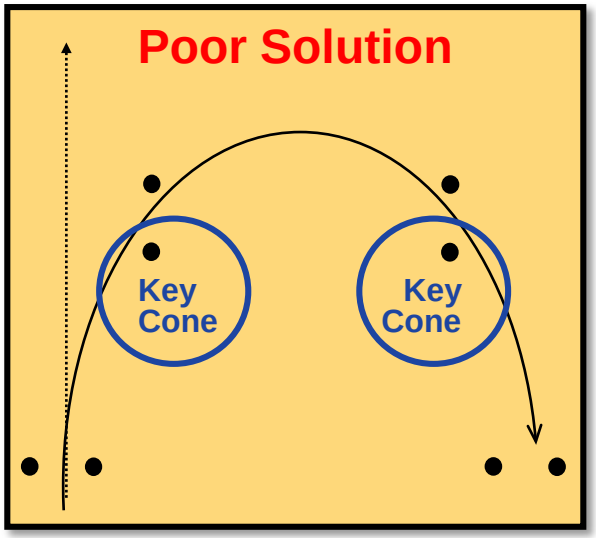
Line of Sight and Gate Positioning

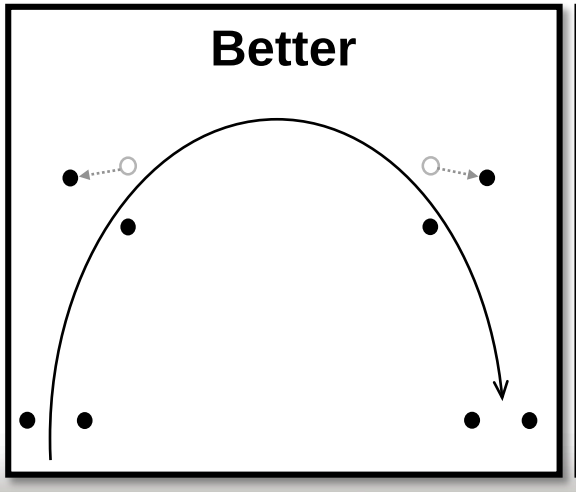
Bad

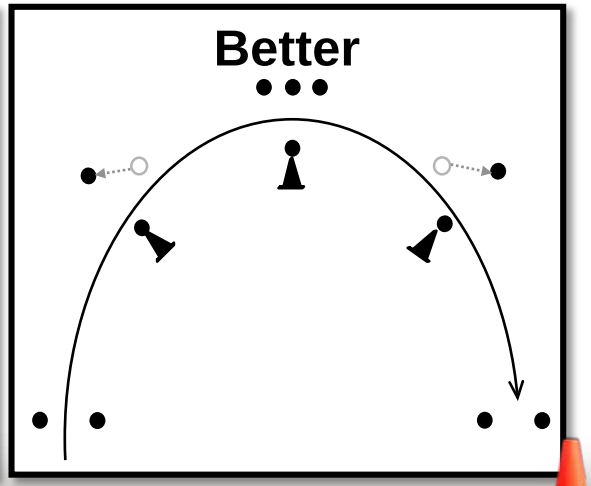


Better









6.) Use Elements that Favor HP and Elements that Favor Handling

- **Use both types of elements is to create an "equalizer" course**
  - This would be one where a **Camaro SS** would have no advantage over a **BMW 323i**, which in 2016 are both in FStreet
  - By doing so, you will have a much greater chance of **pleasing the majority** of the drivers in attendance
- **First decide what favors horsepower and what favors handling**
  - Then evenly apply those kinds of maneuvers in your design
  - In a over simplified explanation:

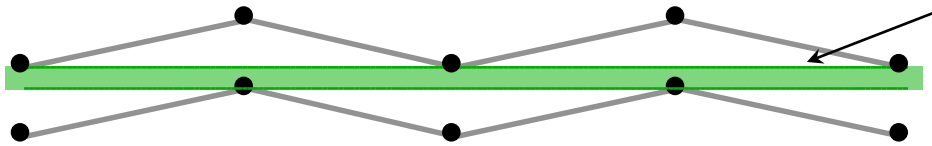
horsepower	handling
straights (duh...)	short to medium spaced slaloms
long spaced slaloms and large radius sweeping turns	small radius sweeping turns
sharp turns (90 degree or more)	chicane/lane changes
maneuvers connected with straights	successive maneuvers
open maneuvers	tight maneuvers
etc.	etc.

- **A straight is any area where full acceleration can be utilized, and is not just the classic definition of the shortest distance between two points**
  - A slalom spaced greater than 100' can be considered a straight

Utilize “the Gap” to Help Control Speed

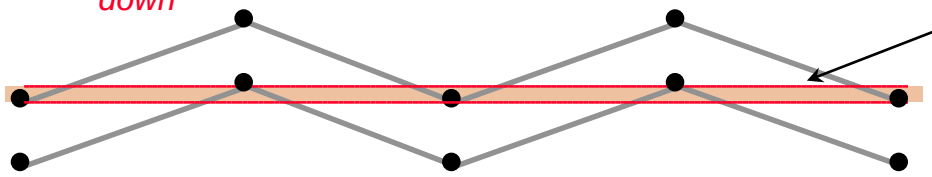
Use either easy or difficult maneuvers to speed up or slow down a course without disrupting the flow

Version "A"
Speed things up



*By increasing this **gap**, you will effectively **increase the speed** of the maneuver. A small increase (e.g. one foot) will have a surprisingly large effect*

Version "B"
Slowing things down

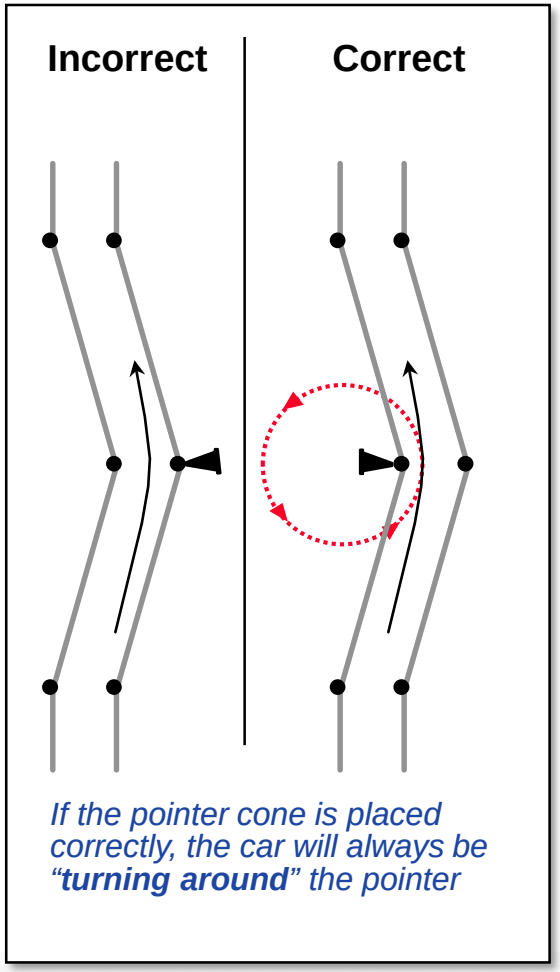


*By increasing this **overlap**, you will effectively **decrease the speed** of the maneuver. A small increase here will also have a surprisingly large effect*

*As was mentioned earlier, it is very important to **draw scale map**. This enables you to **figure out** where the **fast/slow parts** really are. Otherwise your course design will just be a **fantasy** in your mind until the **day of the event**. Placing it on paper allows you the freedom to **actually design** your course rather than depending on **luck or chance.***

7.) Use Pointers and Directionals Correctly and Sparingly

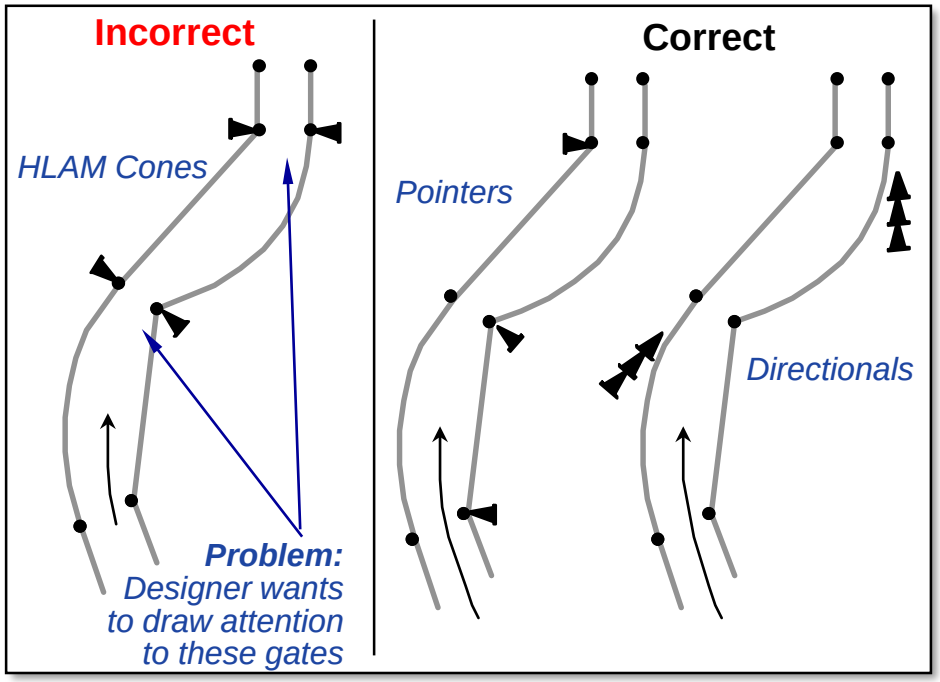
- **Pointers**
  - A **single lay down** cone at the base of a standing cone
    - The **purpose of a pointer** cone is ONLY to indicate the inside of a turn
      - Your car will **always turn around a pointer** if it is placed correctly



*If the pointer cone is placed correctly, the car will always be "**turning around**" the pointer*

Directional Cones

- **Directionals**
  - A series of 3 or more lay down cones to guide the driver to the left or right
  - Choose a set number of cones (such as 3 or more) and always use that amount when placing them on the course
    - Creates a recognizable pattern
    - Driver will see it as a directional set and not a downed cone next to a pointer



- **DO NOT use HLAM* cones – pointers on both sides of a gate**
  - Can be confused with a down cone that a worker has not noticed
  - HLAM cones can make a driver turn the wrong way
    - Pointer cones are supposed to be on the inside of a turn

** HLAM = Hey - Look At Me*

8.) Line the Course

- **Line the course whenever possible**
  - It helps the inexperienced driver to make it through the course with out a DNF
  - Lessens the chance for a “cross-over”, into an oncoming car
- **The course should NOT be line dependent**
  - The course still must be driven successfully if the **lines are “rained” away**
  - This is accomplished by paying close attention to **basic concept #5**
- **The lining of the course is a visual aid in basic course negotiation: NOT an indication of the correct line to drive**
  - Care should be taken to avoid the “correct line” from **passing over the chalk lines**; and should this not be considered, “open wheel” drivers will complain - rightfully so!
  - Lines should not be so **far outside the cones** as to fall outside of the driver’s vision
- **What to use (in order of preference)**
  - **Flour**: non-caustic, easy to get, bright on pavement, smells like a Bakery!
  - **Marble Dust**: non-caustic, hard to get, not bright on pavement
  - **Fertilizer**: Caustic, easy to get, not bright on pavement, promotes weed growth
  - **Lime**: Extremely caustic, Easy to buy, bright on pavement

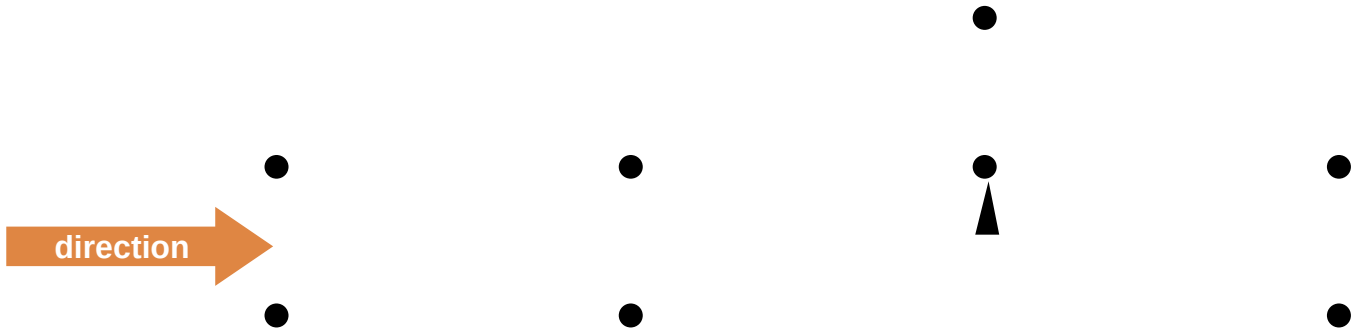
9.) Place Gates to Avoid Visual Confusion

- **Do not place cones or gates at intervals similar to the width of gates being used**
  - For example, do not place gates going around a sweeping turn **25' or 15'** apart if all of your gates are **20'** wide
  - This creates a visual nightmare called "**Cone Hell**" since, at speed, all openings appear to be about the same size - Arrrrgh!!! Which is gap and which is gate?
- **Make all cone walls dense enough so that at any angle, the gaps between them cannot be construed as a gate**
- **When entering a "box" or walled in turn, place the cones that appear in the approach path closer together and more frequently - creating a dense wall in the driver's line of sight**

Gate Spacing
"Rule of Thumb

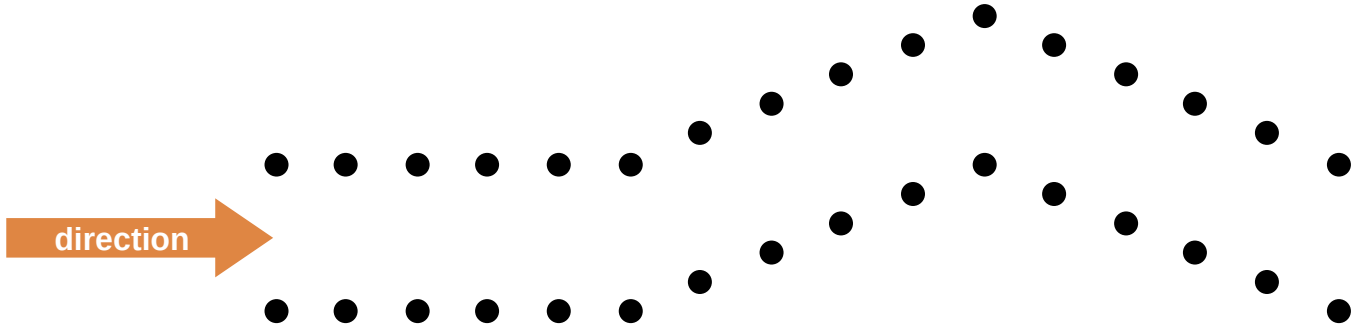
Gated Courses

Ratio of gate width to gate spacing should be 1 to 3 or greater.
For example, if your gate width is 20 feet the distance between gates would be 60 feet or greater



Miniature Road Courses

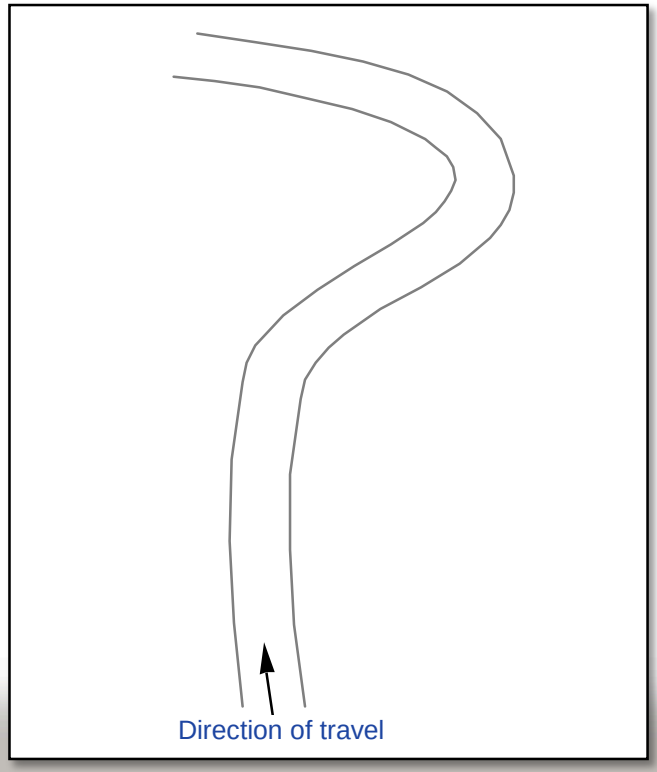
Ratio of gate width to gate spacing should be 2 to 1 or less.
For example, if your gate width is 20 feet, the distance between gates would be 10 feet or less



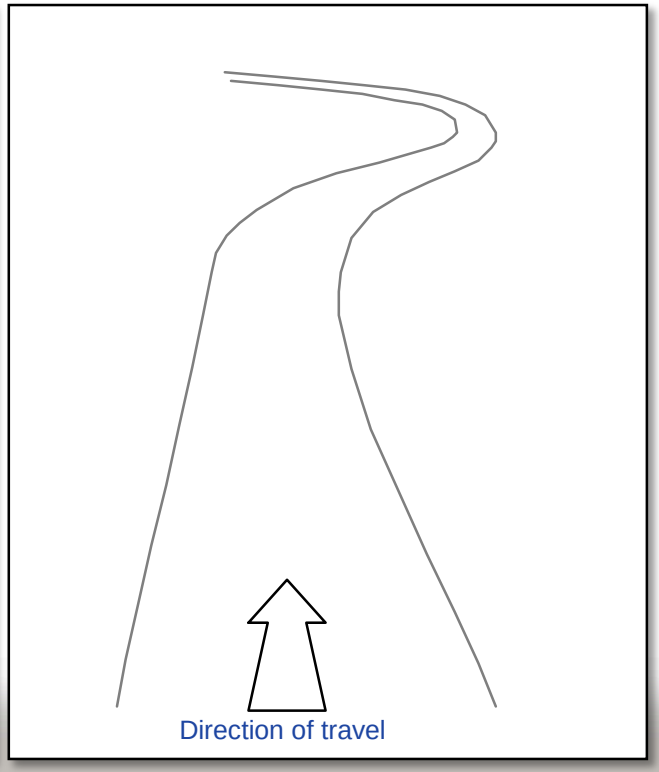
Plan and Perspective views

- **The following examples show a plan view and a perspective view of certain situations so that you can better visualize the cone configuration being indicated**
  - What you see below is the basic path that the next 3 examples are going to take

Plan View



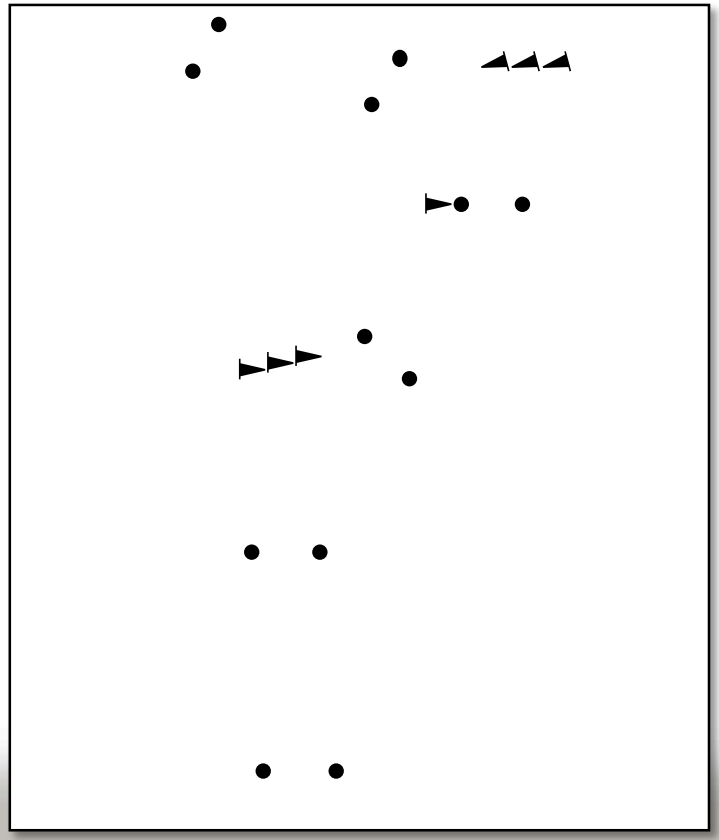
Perspective View



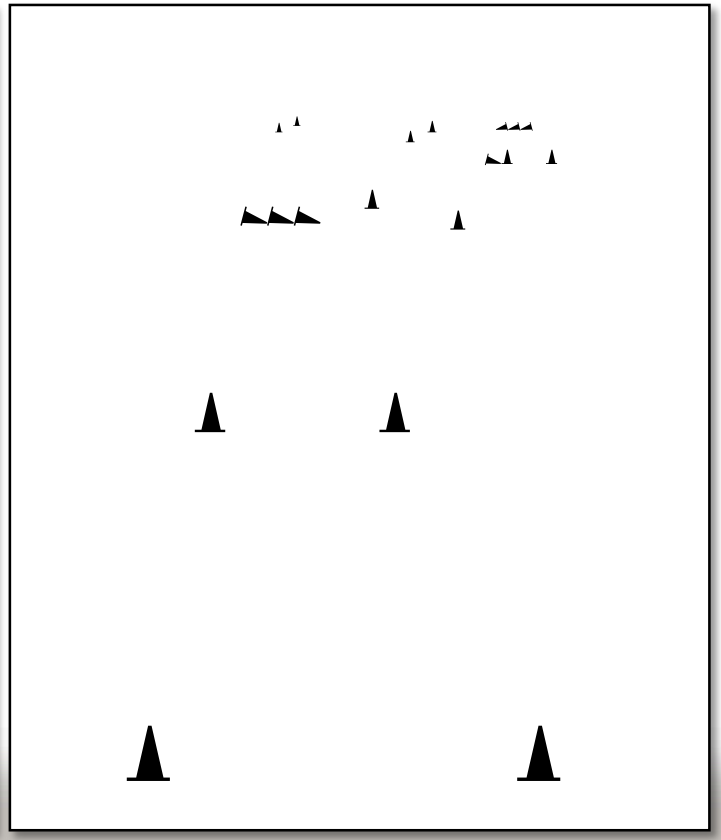
Gates and Pointers

- This is an example of proper use of gates and pointers. The pathway is quite clear and easy to follow

Plan View



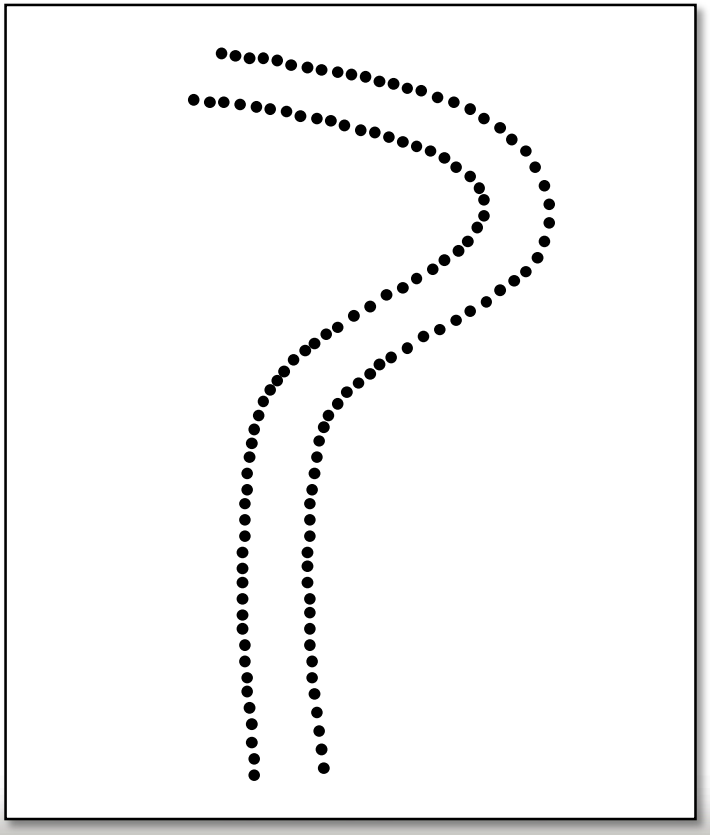
Perspective View



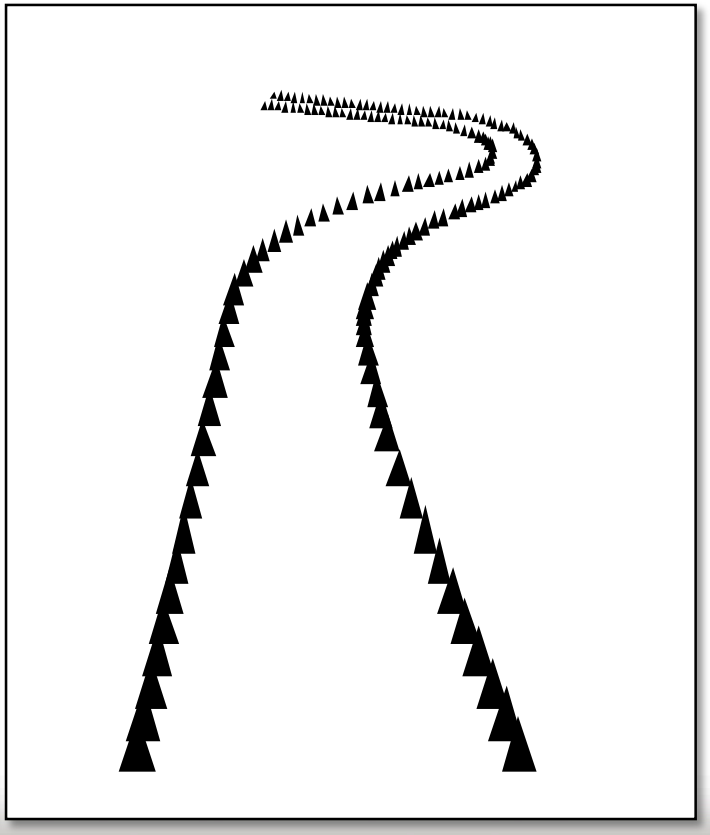
Wall-o-Cones or Miniature Road Course (MRC)

- This is an example of the proper use of the miniature road course technique. The pathway for this is also quite clear and easy to follow

Plan View



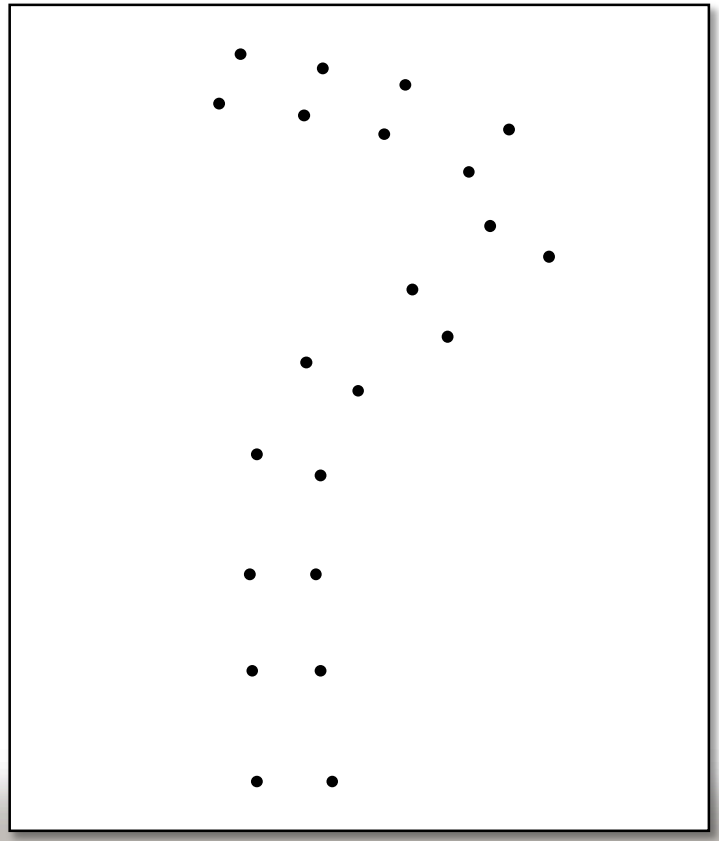
Perspective View



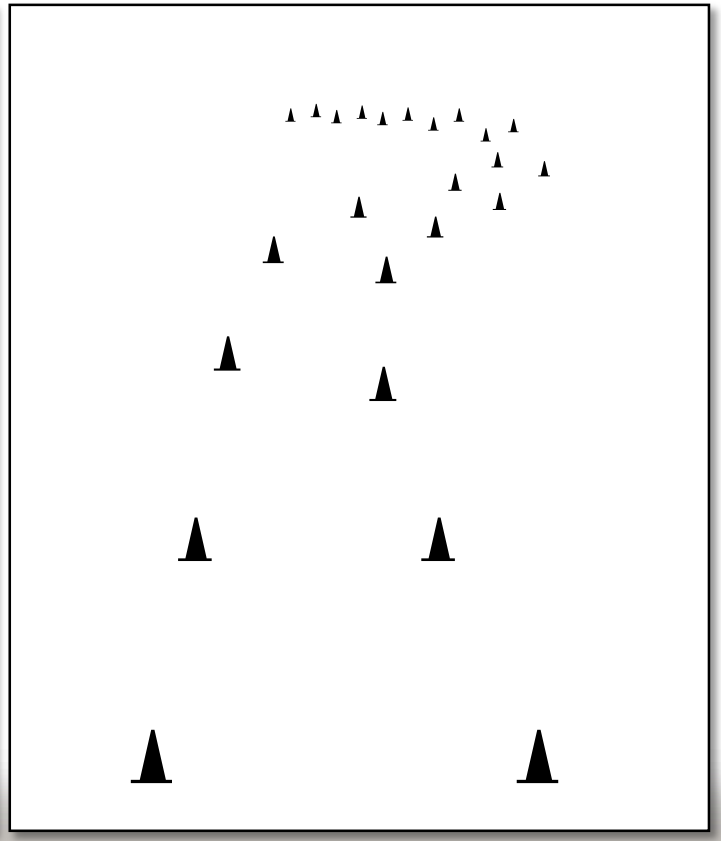
the Dreaded "Sea of Pylons"

The dreaded sea of pylons shown here is the result of using spacing of gates similar to the gate width. As seen in the perspective view, the curve in the distance becomes vague and difficult to follow. When at speed, this effect is worsened since your mind has less time to process what is placed before it

Plan View



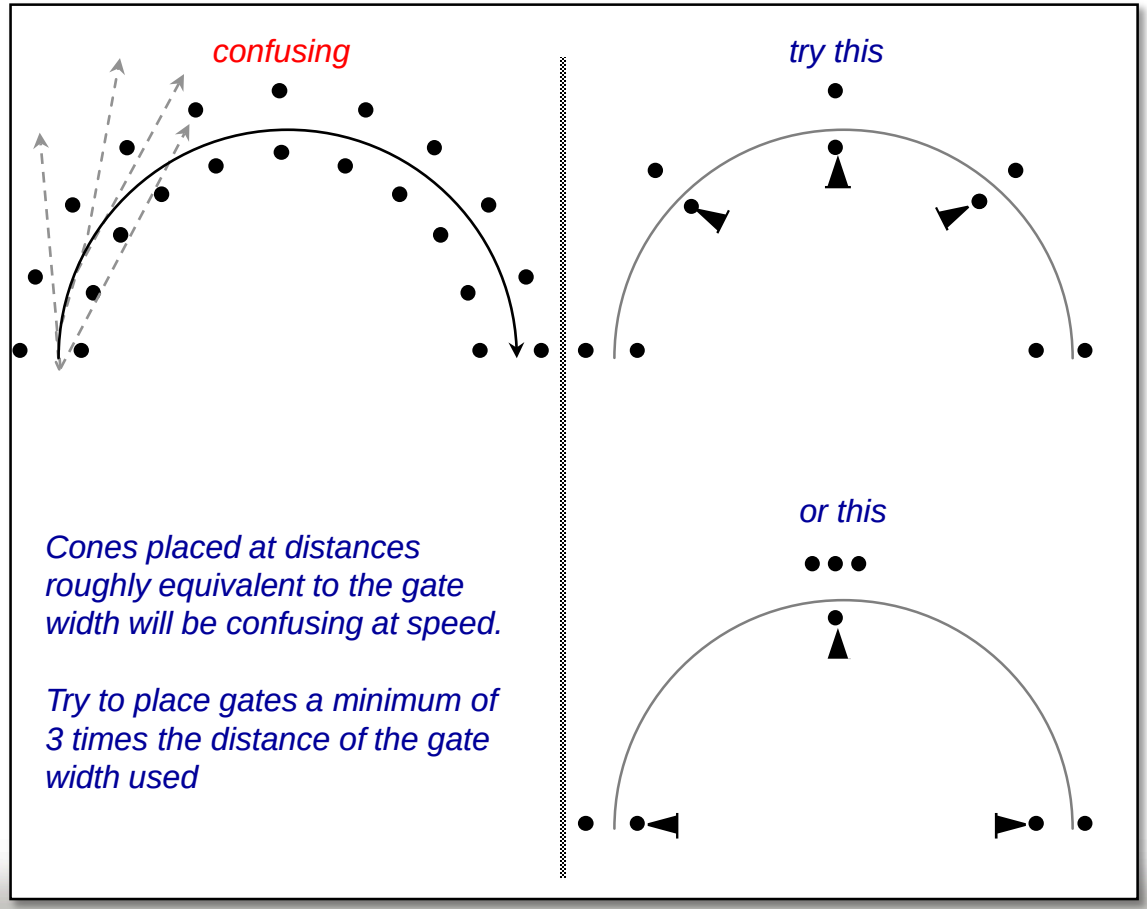
Perspective View



More Examples of "Cone Hell"

Other examples that demonstrate the importance of gate spacing

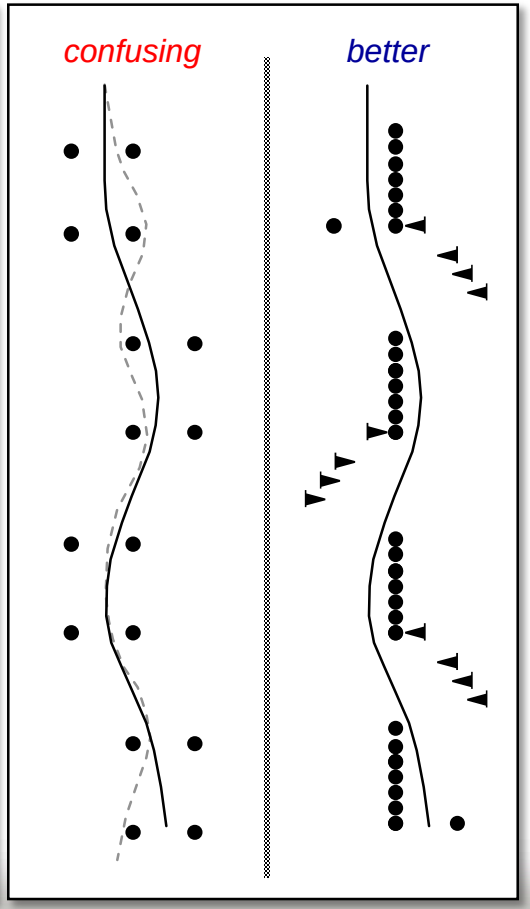
Sweeper



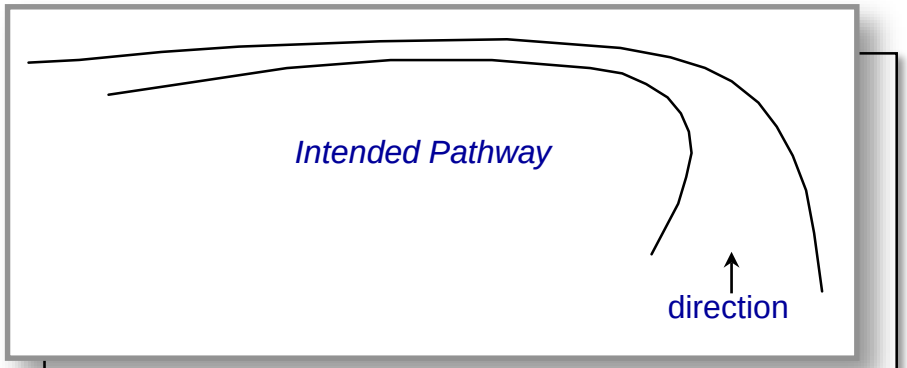
Cones placed at distances roughly equivalent to the gate width will be confusing at speed.

Try to place gates a minimum of 3 times the distance of the gate width used

Lane Change

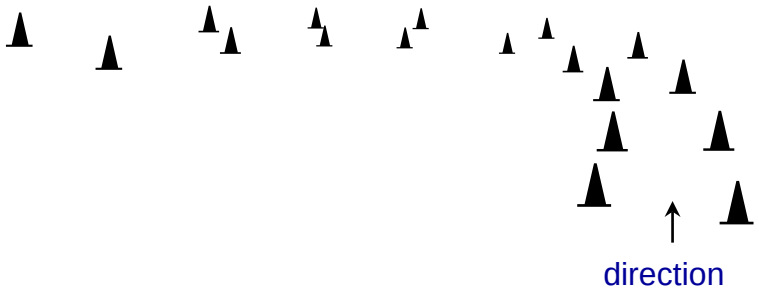


Sweeper - Perspective View

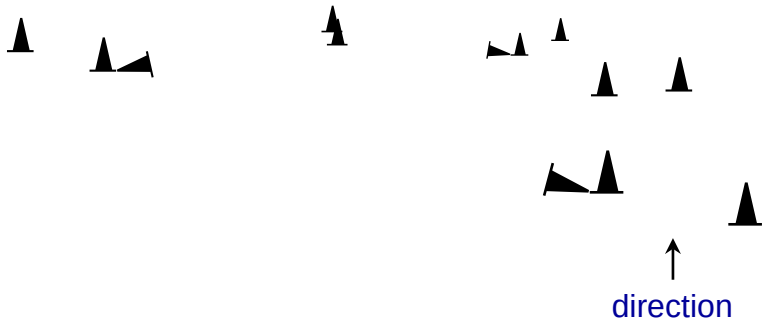


could be confusing

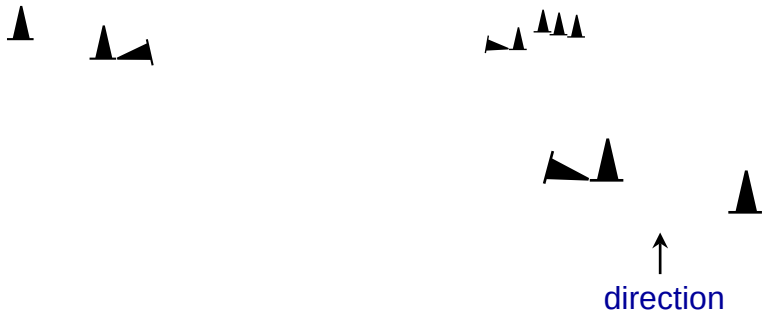
Placing cones at similar intervals as gate width causes this effect which can be confusing at speed



try this

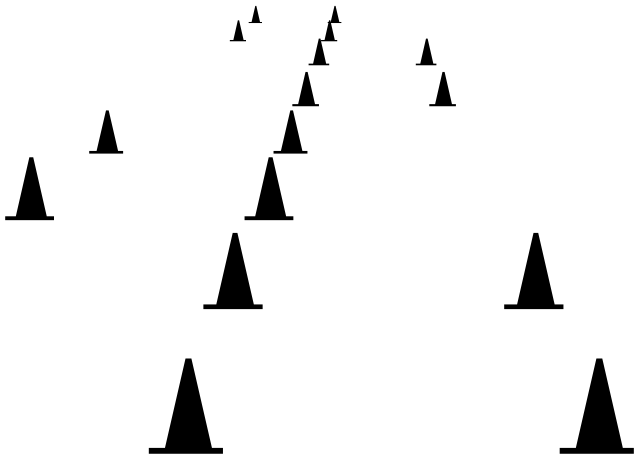


or this

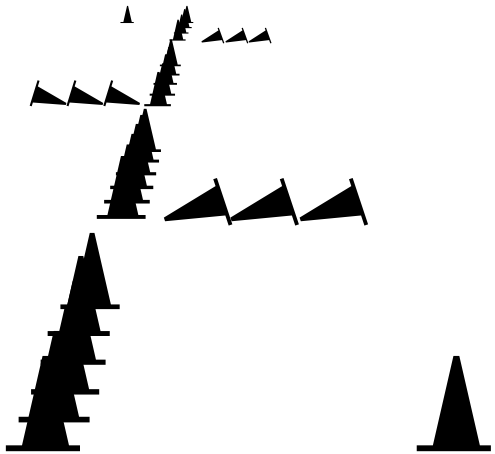


Lane Change Perspective View

sea of cones

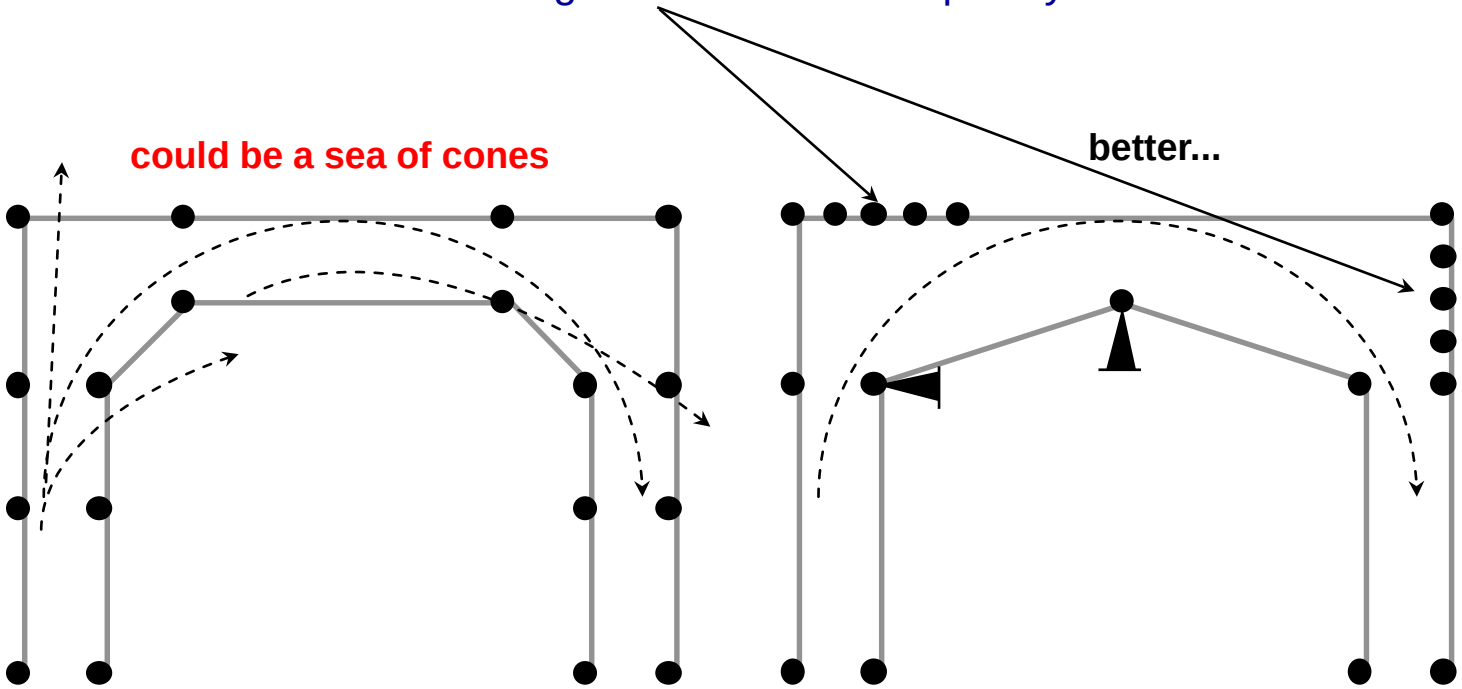


better

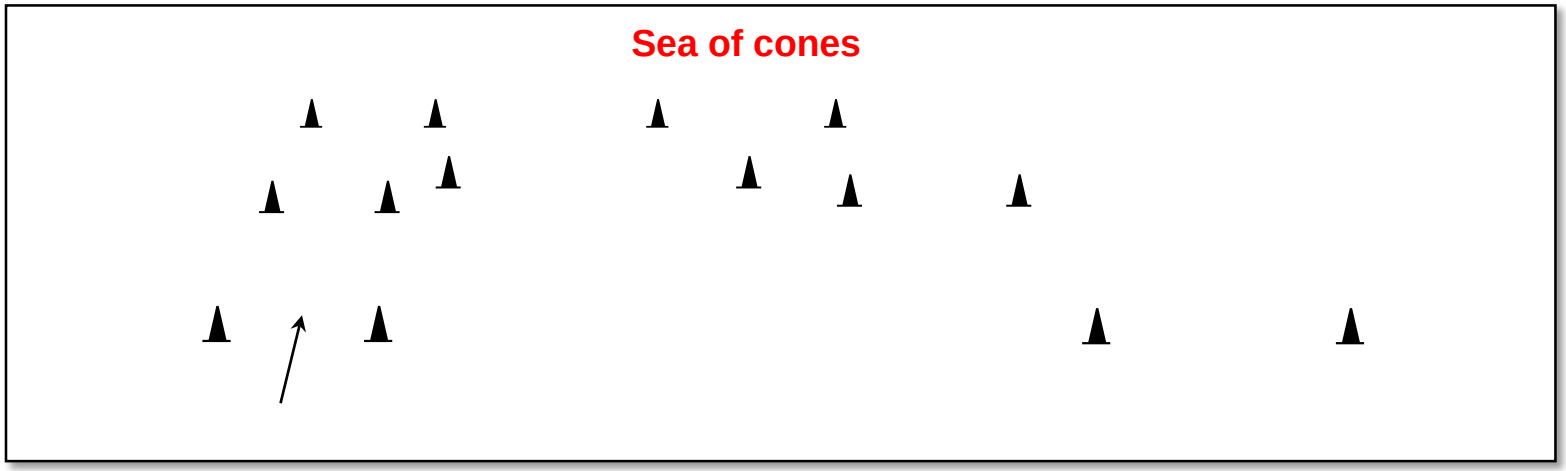


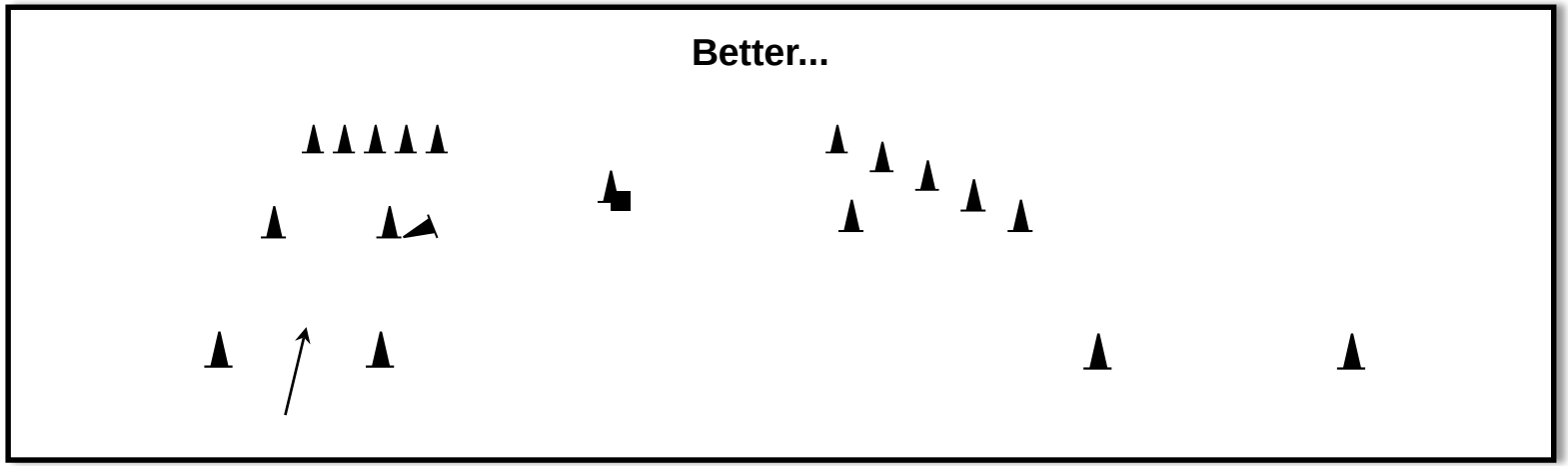
Box Turns

When entering a “box” or walled in turn
place the cones that appear in the approach path
closer together and more frequently



Box Turns
Perspective View





10.) Walk & Drive your course with the Intent of Improvement

- **Always walk and drive your course after its initial set-up with the intent of changing it to improve the flow**
  - I have never drawn a course, set it up and not **changed at least one thing**
    - **Keep the basic concept** of your maneuver, but improve it to make it more fun
    - Maybe it was too tight, or too fast, or visually hard to see
    - What ever the shortcoming, this is the **perfect time to fix it**
- **Take an experienced course designer and Safety Steward with you**
  - **You are there** when they have a suggestion
  - You are able to **control** the types of changes the Safety Steward makes (to maintain the basic concept of the maneuver)
  - You can **discuss/analyze** any of the suggestions the experienced course designer comes up with
- **When not a competitor, DRIVE the course to find its shortcomings**
  - If you are a competitor, designate a non-competitor whose Solo course design opinions you trust to **drive the course** - and not Aunt Ethel (unless she is an AutoXer)
  - Make your **design changes based on** the inputs received from the above

Be a Commercial Artist, NOT a Fine Artist

Agenda

- Fundamentals
- 10 Basic Concepts
- So you have a Blank Piece of Paper...
- Elements, Dimensions and Real Speed
- Summary and Questions

So You Have a Blank Piece of Paper

(DOH!! what now???)

- **These techniques will enable you to put your ideas and the 10 basic concepts you've just gone over down on a piece of paper**
  - I have found that at times, a **blank piece of paper** can be extremely intimidating
  - The following section will hopefully **alleviate that problem** and make this task easier for you as it has for me

Before You Start Your Glorious Creation

- **Make the job easier and improve your chances of success – acquire or make a reasonable scale map of the event site that contains the following information:**
  - The **accurate** overall shape and size of the course area
  - Map scale information
    - Dimensions of **parking stalls, Concrete square** dimensions
  - Locations of:
    - Surface anomalies (**grates**, **holes**, **oil**, etc.); **Immovable objects** (light poles, buildings, curbs, trees, etc.); **Boundary** features (fences, sidewalks streets, etc.); **Entrance** and **Exits; Elevation** changes or sloped sections
- **Address location/logistics of all non-course features on your map as well**
  - Site entrance(s)
  - Waiver patrol points
  - Pit areas
  - Grid
  - Spectator areas
  - Registration
  - Technical inspection
  - Number of cones
  - Timing vehicle/trailer/tent
  - Finish placement/run-out

Off Camber Surfaces, Bumpy Lots/Changing Surfaces

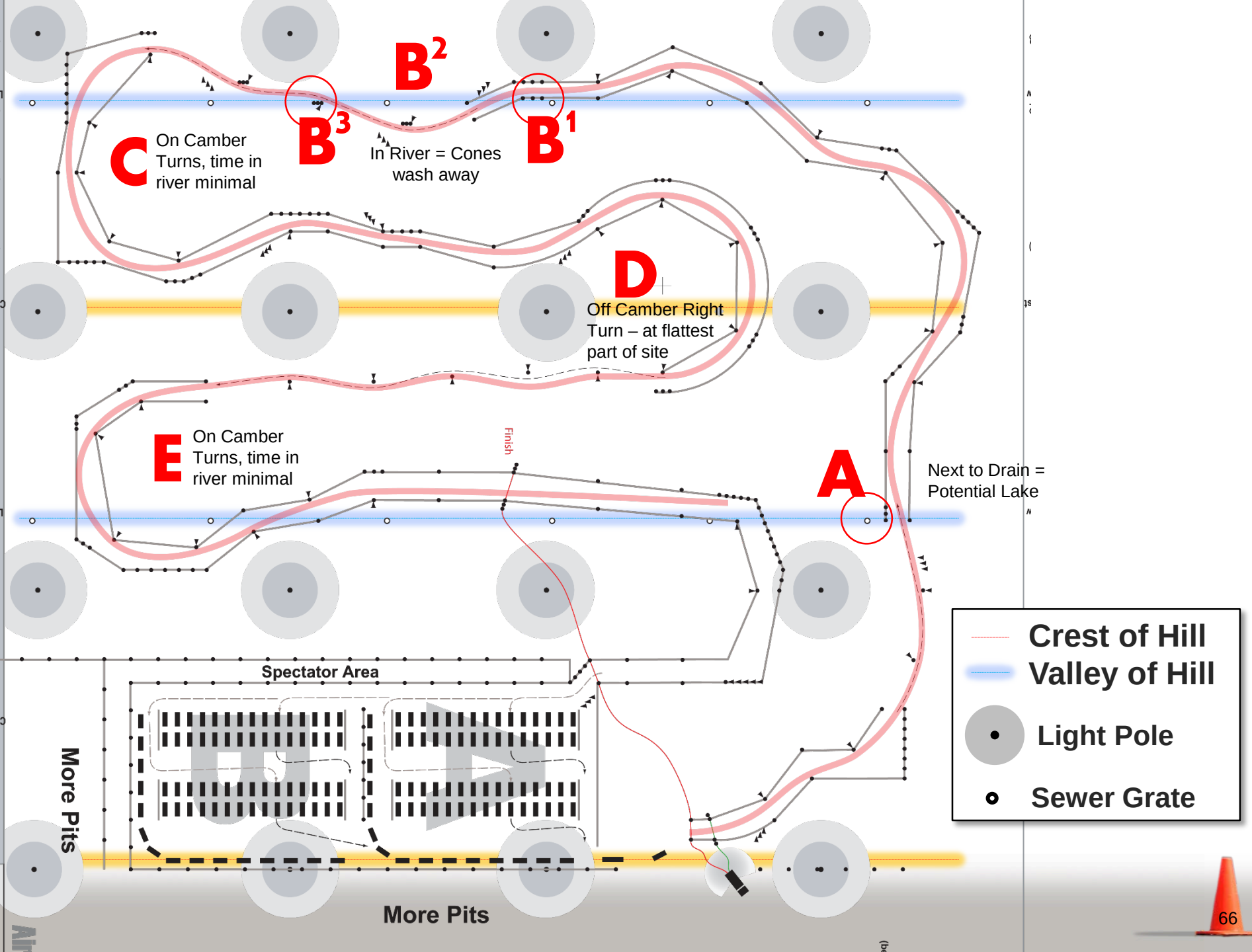
Why We Care

- **Any category beyond Stock can have major issues**
  - **Even some Stock cars** can be broken by these things
- **Ground clearance**
  - Damage to **bodywork/aero**, to **engine**, to **frame**, etc.
- **Suspension travel**
  - **Bottoming out** is not only bad for driving but can break things and in a worst case lead to a rollover
- **Getting airborne**
  - Powered wheel spins uncontrolled, then can **break axles/diffs/trannies** when it comes back down
- **Hard on driver**
  - Think **AM, BM, CM, FM, FJr,** etc.
- **Loss of control potential is larger (spins happen easier)**

Off Camber Surfaces, Bumpy Lots/Changing Surfaces

What We Care About

- **Ridges**
- **Valleys**
- **Camber changes**
- **Grates, holes, patches, metal plates, things to just plain not hit**
- **Washboard sections**
- **Concrete seam drop-offs and step-ups**
  - A step-up is worse, but a drop-off can be an axle breaker
  - If it's more than an inch, either way, avoid it
- **Low areas where water can accumulate**

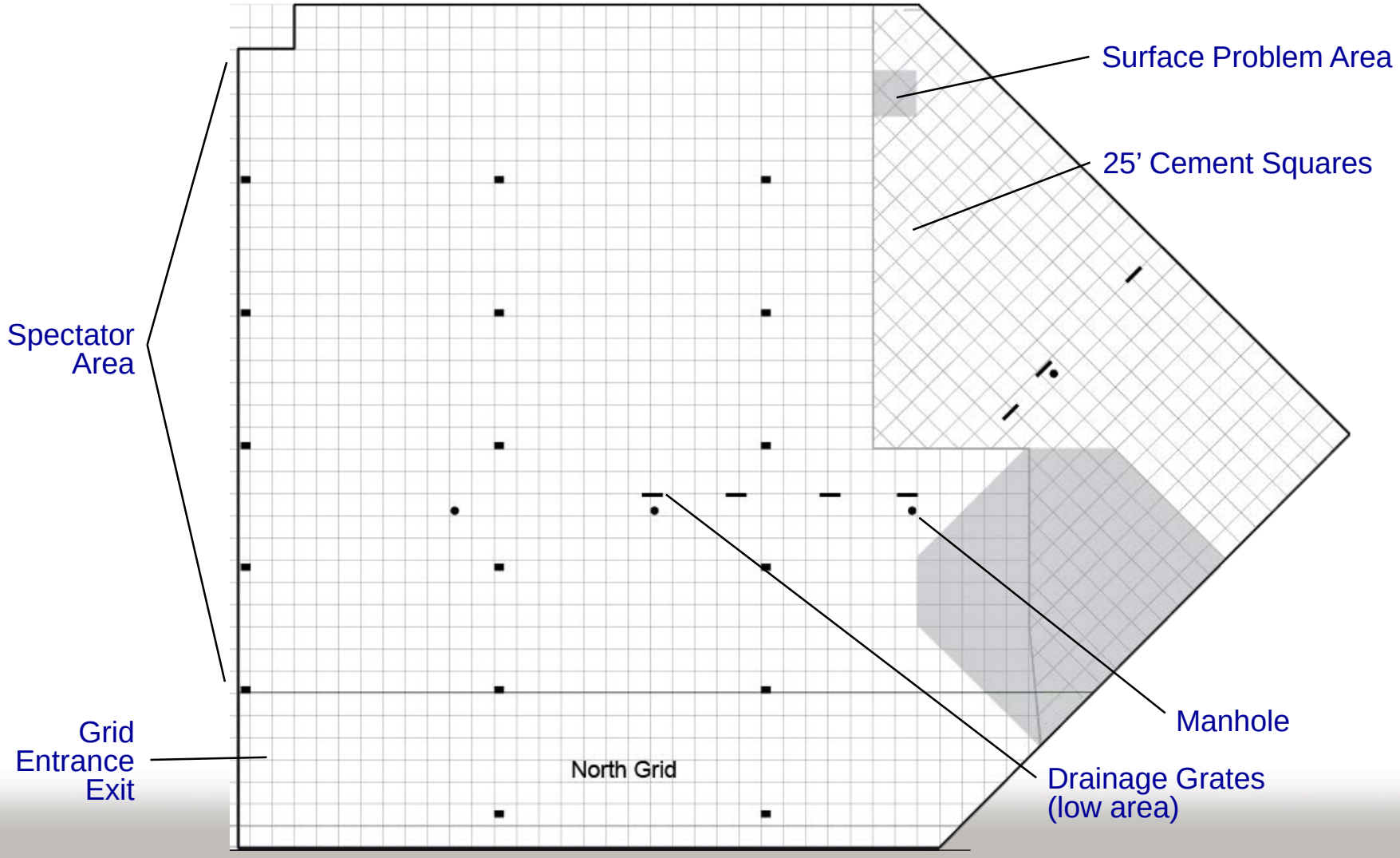

B2
B3
B1
C
On Camber Turns, time in river minimal
In River = Cones wash away
D
Off Camber Right Turn – at flattest part of site
E
On Camber Turns, time in river minimal
Finish
A
Next to Drain = Potential Lake
Spectator Area
More Pits
More Pits
Crest of Hill
Valley of Hill
Light Pole
Sewer Grate

Off Camber Surfaces, Bumpy Lots/Changing Surfaces

What To Do

- **Cross ridges and valleys at an angle (the shallower the better) while going straight and preferably not braking**
  - The **closer to parallel** with the groove or ridge you are, the shallower the ditch or peak effectively becomes.
  - This also lets the corners of the car's **suspension work independently** to absorb the deflections.
- **Put a cone on grate/hole/patch/plate**
  - Make it part of the **course marking** boundary
- **Avoid washboard section if possible**
  - Traverse at **lower speed**, or at least with **no turning or braking** if not
- **Avoid low areas if possible, or make the time in them minimal**
  - Rain is a factor - you can't brake or turn when hydroplaning on a **puddle/river/lake**
- **Reduce speed of crossing for drop-offs and step-ups, cross at angle**
  - Try to have cars **not braking** or **accelerating** when they cross it

Scale Map of the Topeka North Course Area



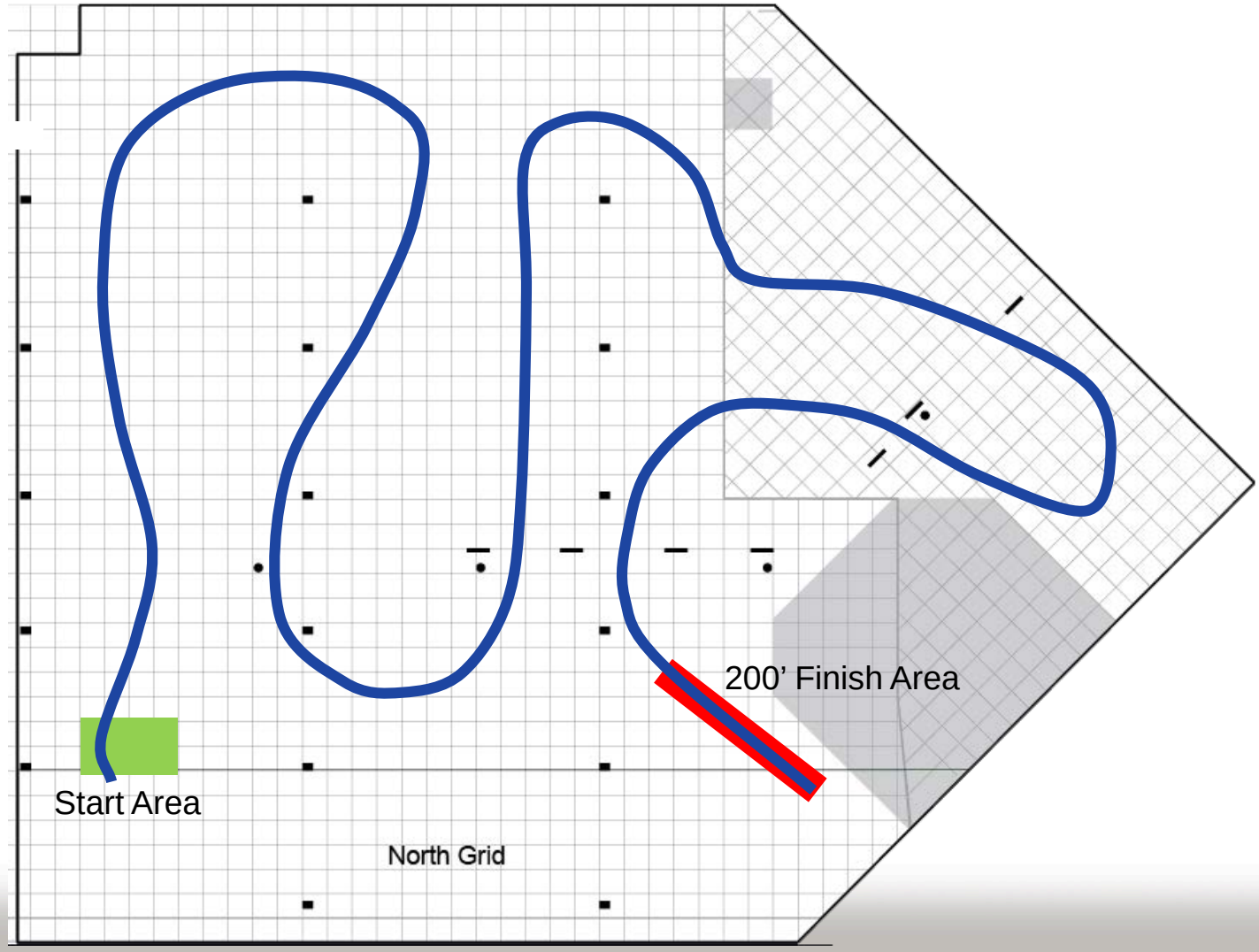
Getting Started (Finally...)

Position the Start and Finish

- **Position the finish area first**
  - **Runoff** and **type of finish**
  - Define **exit/return route** to grid
  - Location of **finish lights**
  - Clear view from **Timing**
  - Avoid **maneuvers** at the lights
  - Avoid the **brakes** at the lights
- **Position the start area next**
  - **Staging** line and **type of start**
  - **Access** from the grid
  - Location of the **start lights**
  - Clear view from **Timing**
  - Place **sharp turn** just **prior** to or just **after** the lights to prevent the need of dumping the clutch
- **Sketch General Route**
  - Do **several** general sketches
  - Anticipate **corner worker positions**
  - Note **boundaries** and **immovable objects**
  - Avoid **crossovers**
  - Provide **separation** between sections

Course Design and Event Setup

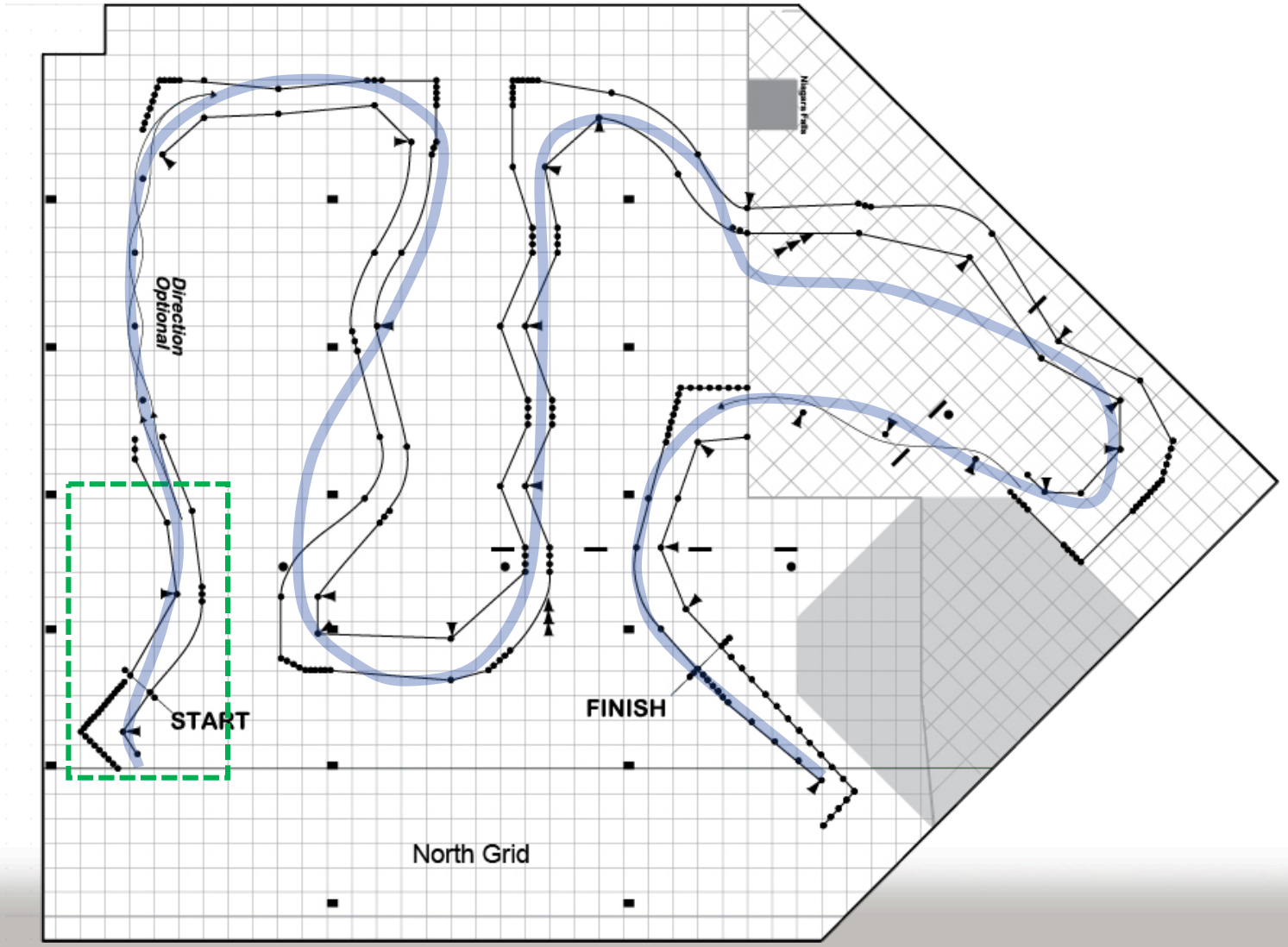
Example of a sketch



Finalizing the Design

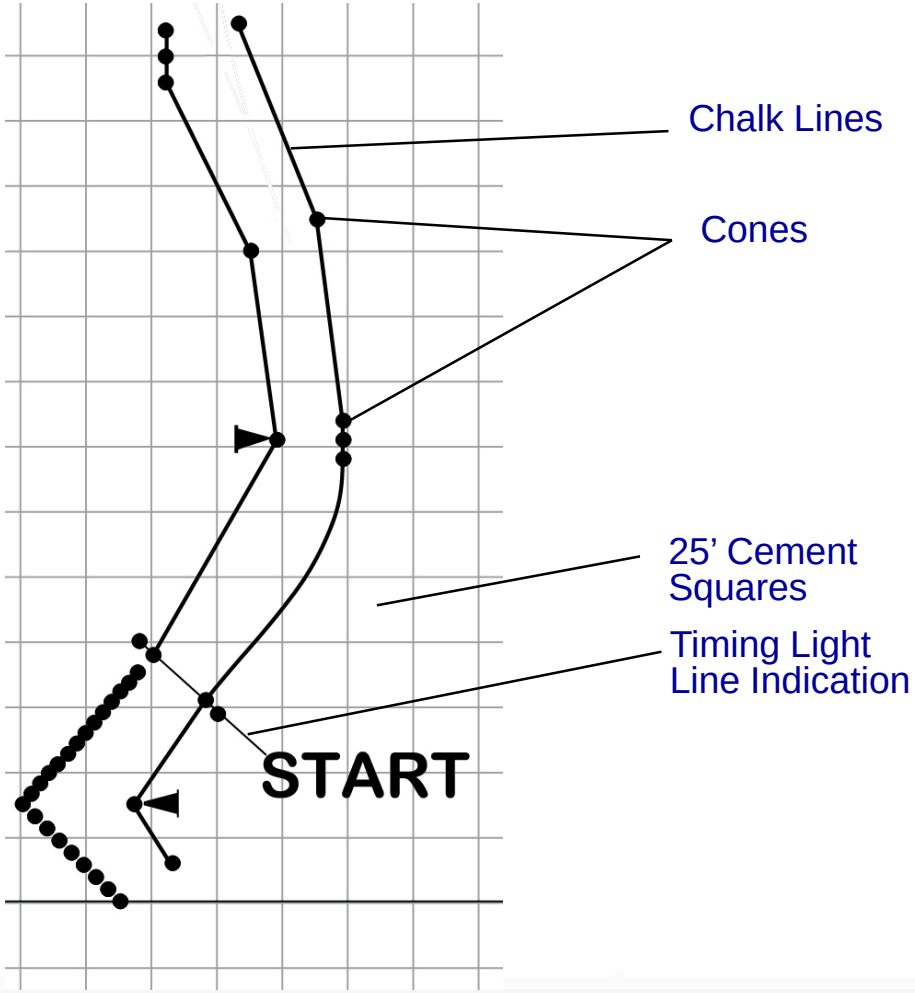
- **Choose a variety of different types of maneuvers and features**
  - **Make a list** of the desired elements
  - Decide which portions of that route **lend themselves** to each of the listed elements
- **Pick the elements that seem the best for your pathway and fill them in**
  - **Adjust** turn radii and shapes
  - **Add** transients where applicable
  - Ensure a **diversity** of elements
- **Add projected cone locations**
  - Don't think **chalk line** will guide drivers
    - **Rain or wind** may eradicate those
  - Allow for room **driver error**
  - Prioritize **key cones**
  - Repeat **cone shapes** to **create patterns**
    - Pointers on apexes
    - Four cone walls on outside of turns
    - Standard gate widths
    - Consistent number of lay downs
  - Avoid **Excess cones** where not required for a desired visual
  - Allow **room for adjustment**
    - no course should be expected to be set up exactly as it was drawn
    - **10' minimum movement** allowance of individual cones, gates or even entire sections

Finalized Design Example



See next page to view this section

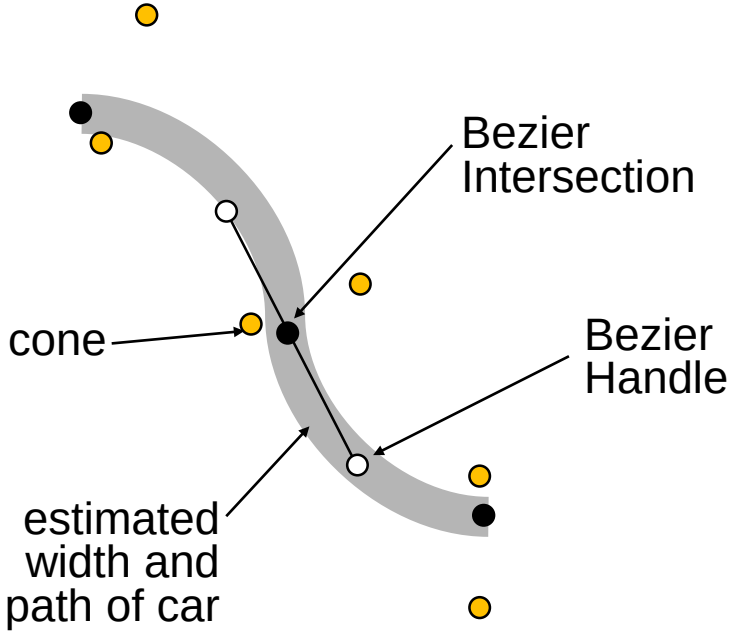
Section from Finalized Design



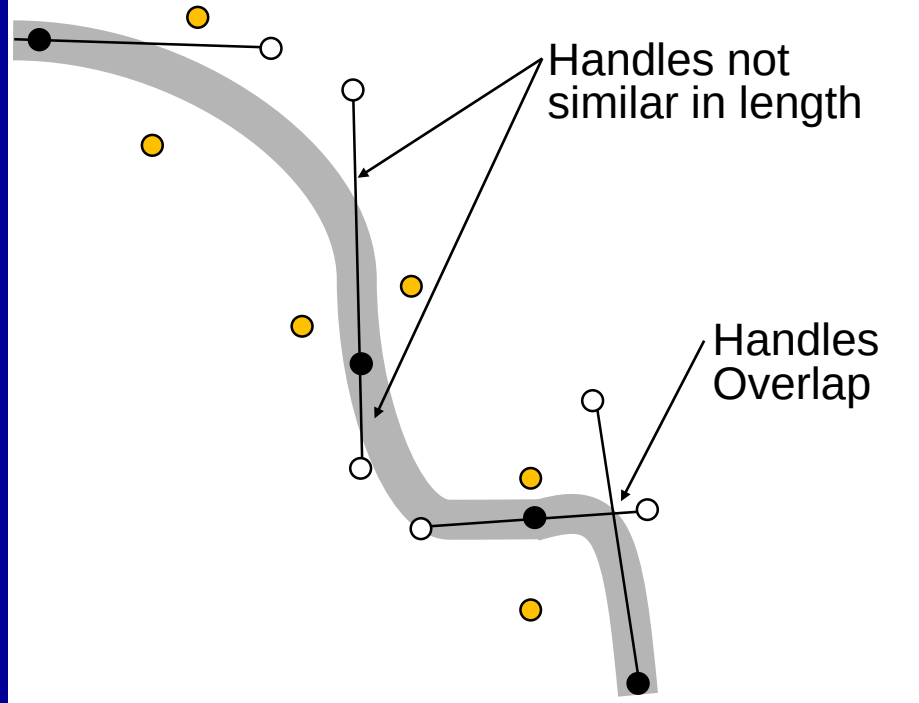
Computer Design Analysis

- **The following assumes that you have access to a fairly powerful computer with a current Graphics program that utilizes bezier curves and lines such as Adobe Illustrator, Xara, Zoner Draw, Deneba Canvas, Corel Draw, etc.**
  - When you input your design into a computer to scale, you can **analyze** how well the **course flows** by plotting the probable path of a car
    - Create a probable path of the car using a bezier curve the approximate width of a car
      - Most cars are about **6 feet wide**
      - Place your bezier intersections at probable **apex points**
    - Adjust the **bezier curves** to create the **fastest (shortest) course path**
      - Strive to have the line as **smooth as possible**
      - Make your bezier handles **similar in length**
      - **Do not** have bezier **handles overlap** each other

Computer Design Analysis
(continued)



Elements of a Bezier Curve



What **NOT** to do

Slalom Speeds in MPH

Lateral G's	Slalom Spacing in Feet													
	45	50	55	60	65	70	75	80	85	90	95	100	110	120
0.90	30	33	36	39	42	46	49	52	55	59	62	65	72	78
0.95	30	34	37	40	44	47	50	54	57	60	64	67	74	80
1.00	31	35	38	41	45	48	52	55	58	62	65	69	75	82
1.05	32	35	39	42	46	49	53	56	60	63	67	70	77	84
1.10	33	36	40	43	47	51	54	58	61	65	68	72	79	86
1.15	34	37	41	44	48	52	55	59	63	66	70	74	81	88
1.20	34	38	42	45	49	53	57	60	64	68	71	75	83	90
1.25	35	39	42	46	50	54	58	61	65	69	73	77	84	92
1.30	36	39	43	47	51	55	59	63	67	70	74	78	86	94
1.35	36	40	44	48	52	56	60	64	68	72	76	80	88	96
1.40	37	41	45	49	53	57	61	65	69	73	77	81	89	97
1.45	38	42	46	50	54	58	62	66	70	74	79	83	91	99
1.50	38	42	47	51	55	59	63	67	72	76	80	84	92	101

- **Expect <0.90 from stock cars on street tires, 1.10 g's from more prepared cars on race tires, 1.20 g's from a non-winged car such as C Mod, and 1.45 g's from a winged mod car**
  - Calculations are based on a constant radius, instantaneous transition model

Course Design and Event Setup

Cornering Speeds in MPH

Lateral Gs	Radius of Turn in Feet																
	20	30	40	50	60	70	80	90	100	125	150	175	200	250	300	350	400
0.90	16	20	23	26	28	31	33	35	37	41	45	49	52	58	64	69	73
0.95	17	21	24	27	29	32	34	36	38	42	46	50	53	60	65	71	75
1.00	17	21	24	27	30	32	35	37	39	43	47	51	55	61	67	72	77
1.05	18	22	25	28	31	33	35	38	40	44	49	52	56	63	69	74	79
1.10	18	22	26	29	31	34	36	38	41	45	50	54	57	64	70	76	81
1.15	19	23	26	29	32	35	37	39	41	46	51	55	59	66	72	78	83
1.20	19	23	27	30	33	35	38	40	42	47	52	56	60	67	73	79	85
1.25	19	24	27	31	34	36	39	41	43	48	53	57	61	68	75	81	87
1.30	20	24	28	31	34	37	39	42	44	49	54	58	62	70	76	83	88
1.35	20	25	28	32	35	38	40	43	45	50	55	59	64	71	78	84	90
1.40	20	25	29	32	35	38	41	43	46	51	56	61	65	72	79	86	92
1.45	21	26	29	33	36	39	42	44	47	52	57	62	66	74	81	87	93
1.50	21	26	30	34	37	40	42	45	47	53	58	63	67	75	82	89	95

- **Expect <0.90 from stock cars on street tires, 1.10 Gs from Stock and SP cars on race tires, 1.20 Gs from a non-winged car such as C Mod, and 1.45 Gs from a winged mod car**
  - During analysis, be aware of the wide line which can affect the outcome

So You Have a Blank Piece of Paper

Course Design and Event Setup

Acceleration and Braking Distances in Feet

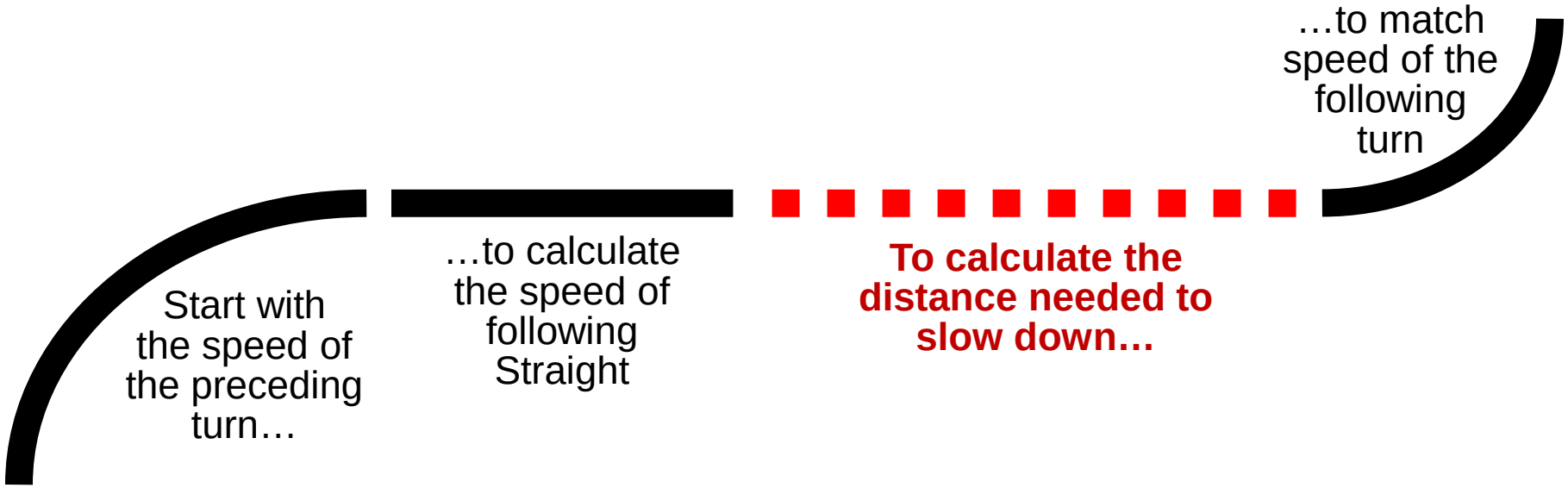
- **Acceleration distances**
  - The **blue/gray** portion is used to estimate distance needed to reach a certain speed
  - Based on a **quick SP car**, which could do **0 - 60 mph** in **4.1 secs**

- **Braking distances**
  - The **pink** half of the chart is used to estimate braking distances of lower performance cars and for estimating stop box length
  - Based on **constant 0.8 g braking**,(typical published vehicle maximum baking effort on street tires)

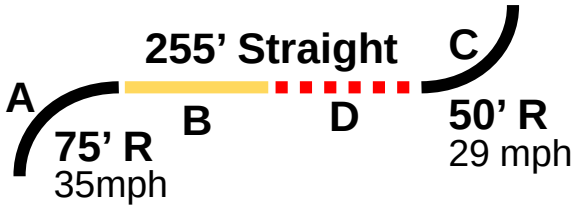
	Starting Speed	Target Speed	Needed Distance
Acceleration Section	35	65	**191**
Braking Section	65	40	**110**

Starting Speed in MPH	Target Speed in MPH													
	0	20	25	30	35	40	45	50	55	60	65	70	75	80
0	0	15	25	37	53	70	94	121	149	180	222	267	311	358
20	*17*	0	12	26	42	62	88	118	149	182	228	277	338	403
25	*26*	*9*	0	14	31	50	77	107	138	171	218	268	330	397
30	*38*	*21*	*11*	0	17	36	63	94	125	158	206	257	320	387
35	*51*	*34*	*25*	*14*	0	19	47	78	109	143	191	243	307	375
40	*67*	*50*	*41*	*29*	*16*	0	28	59	91	125	173	226	291	361
45	*85*	*68*	*58*	*47*	*33*	*18*	0	31	62	96	145	198	264	335
50	*104*	*88*	*78*	*67*	*53*	*38*	*20*	0	31	65	114	167	234	305
55	*126*	*110*	*100*	*89*	*75*	*60*	*42*	*22*	0	34	84	138	205	277
60	*150*	*134*	*124*	*113*	*99*	*83*	*66*	*46*	*24*	0	50	105	173	246
65	*176*	*160*	*150*	*139*	*125*	*110*	*92*	*72*	*50*	*26*	0	54	123	197
70	*205*	*188*	*179*	*167*	*153*	*138*	*120*	*100*	*78*	*54*	*28*	0	69	143
75	*235*	*218*	*209*	*197*	*184*	*168*	*150*	*130*	*109*	*85*	*58*	*30*	0	74
80	*267*	*251*	*241*	*230*	*216*	*200*	*183*	*163*	*141*	*117*	*91*	*63*	*32*	0

Course Design and Event Setup
Practical Application



Course Design and Event Setup
Practical Application



Start Speed (A)	Distance (B)	Ending Speed
35	143	**60**

Brake Speed	End speed (C)	Brake Distance (D)
60	29	**113**

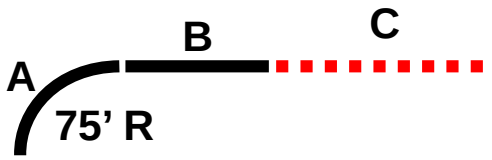
- **Calculate braking distance**
  - Determine speed of turn **A**
  - Determine speed of straight **B**
    - Speed of A and length of straight = speed
  - Determine speed of turn **C**
  - Calculate braking distance needed for **D**
    - Speed of B and target speed of C = braking distance
  - 143' acceleration + 113' brake = 256' straight

Starting Speed in MPH	Target Speed in MPH													
	0	20	25	30	35	40	45	50	55	60	65	70	75	80
0	0	15	25	37	53	70	94	121	149	180	222	267	311	358
20	17	0	12	26	42	62	88	118	149	182	228	277	338	403
25	26	9	0	14	31	50	77	107	138	171	218	268	330	397
30	38	21	11	0	17	36	63	94	125	158	206	257	320	387
35	51	34	25	14	0	19	47	78	109	143	191	243	307	375
40	67	50	41	29	16	0	28	59	91	125	173	226	291	361
45	85	68	58	47	33	18	0	31	62	96	145	198	264	335
50	104	88	78	67	53	38	20	0	31	65	114	167	234	305
55	126	110	100	89	75	60	42	22	0	34	84	138	205	277
60	150	134	124	113	99	83	66	46	24	0	50	105	173	246
65	176	160	150	139	125	110	92	72	50	26	0	54	123	197
70	205	188	179	167	153	138	120	100	78	54	28	0	69	143
75	235	218	209	197	184	168	150	130	109	85	58	30	0	74

Lateral Gs	Radius of Turn in Feet																
	20	30	40	50	60	70	80	90	100	125	150	175	200	250	300	350	400
1.10	18	22	26	29	31	34	36	38	41	45	50	54	57	64	70	76	81

Course Design and Event Setup

Practical Application



Start Speed (A)	Distance (B)	Ending Speed
35	143	**60**

Brake Speed	End speed (C)	Brake Distance (D)
60	0	**150**

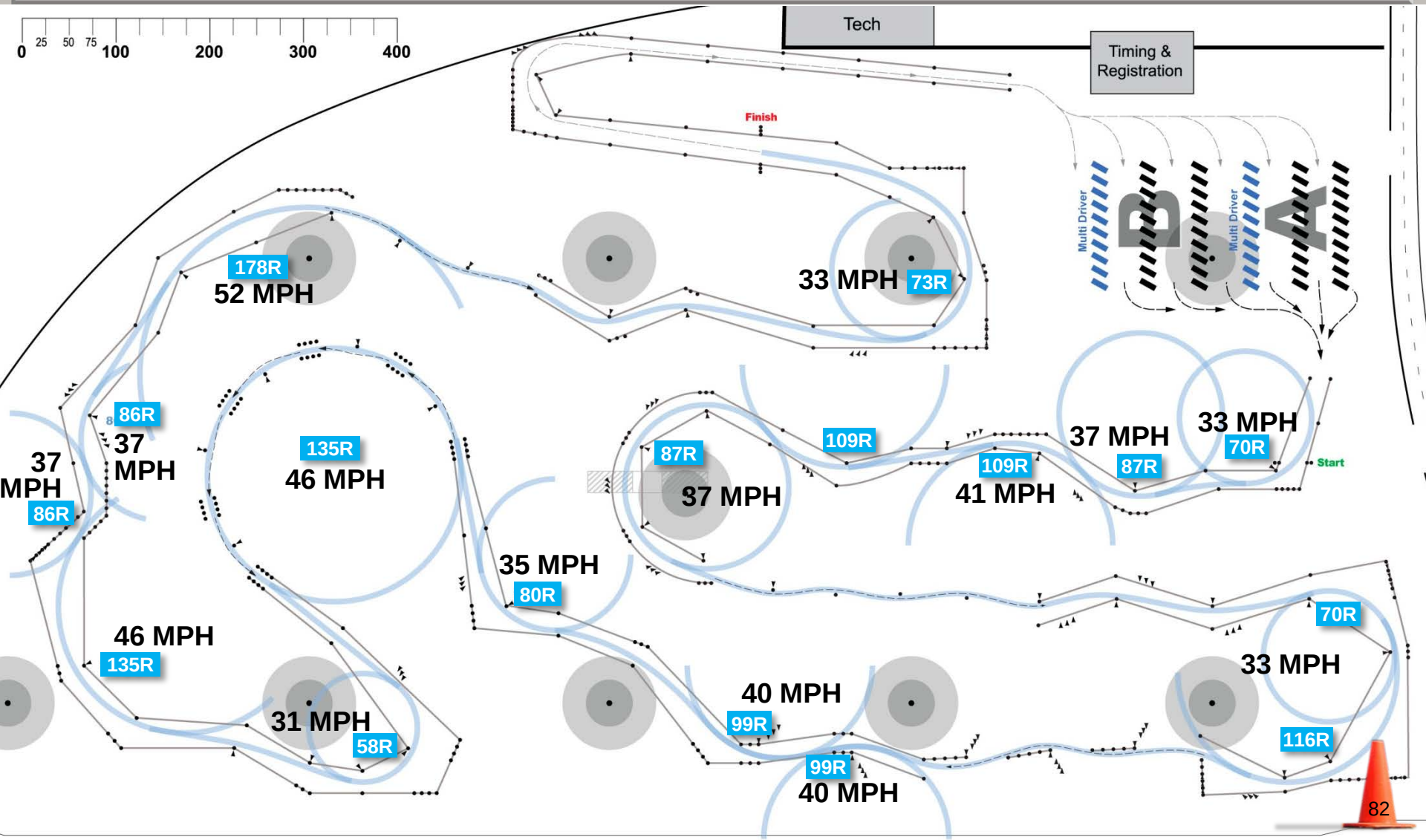
- **Calculate stop box length**
  - Determine speed of turn **A**
  - Determine speed of straight **B**
  - Calculate braking distance to 0 mph needed for **C**

Starting Speed in MPH	Target Speed in MPH													
	0	20	25	30	35	40	45	50	55	60	65	70	75	80
0	0	15	25	37	53	70	94	121	149	180	222	267	311	358
20	17	0	12	26	42	62	88	118	149	182	228	277	338	403
25	26	9	0	14	31	50	77	107	138	171	218	268	330	397
30	38	21	11	0	17	36	63	94	125	158	206	257	320	387
35	51	34	25	14	0	19	47	78	109	143	191	243	307	375
40	67	50	41	29	16	0	28	59	91	125	173	226	291	361
45	85	68	58	47	33	18	0	31	62	96	145	198	264	335
50	104	88	78	67	53	38	20	0	31	65	114	167	234	305
55	126	110	100	89	75	60	42	22	0	34	84	138	205	277
60	150	134	124	113	99	83	66	46	24	0	50	105	173	246
65	176	160	150	139	125	110	92	72	50	26	0	54	123	197
70	205	188	179	167	153	138	120	100	78	54	28	0	69	143

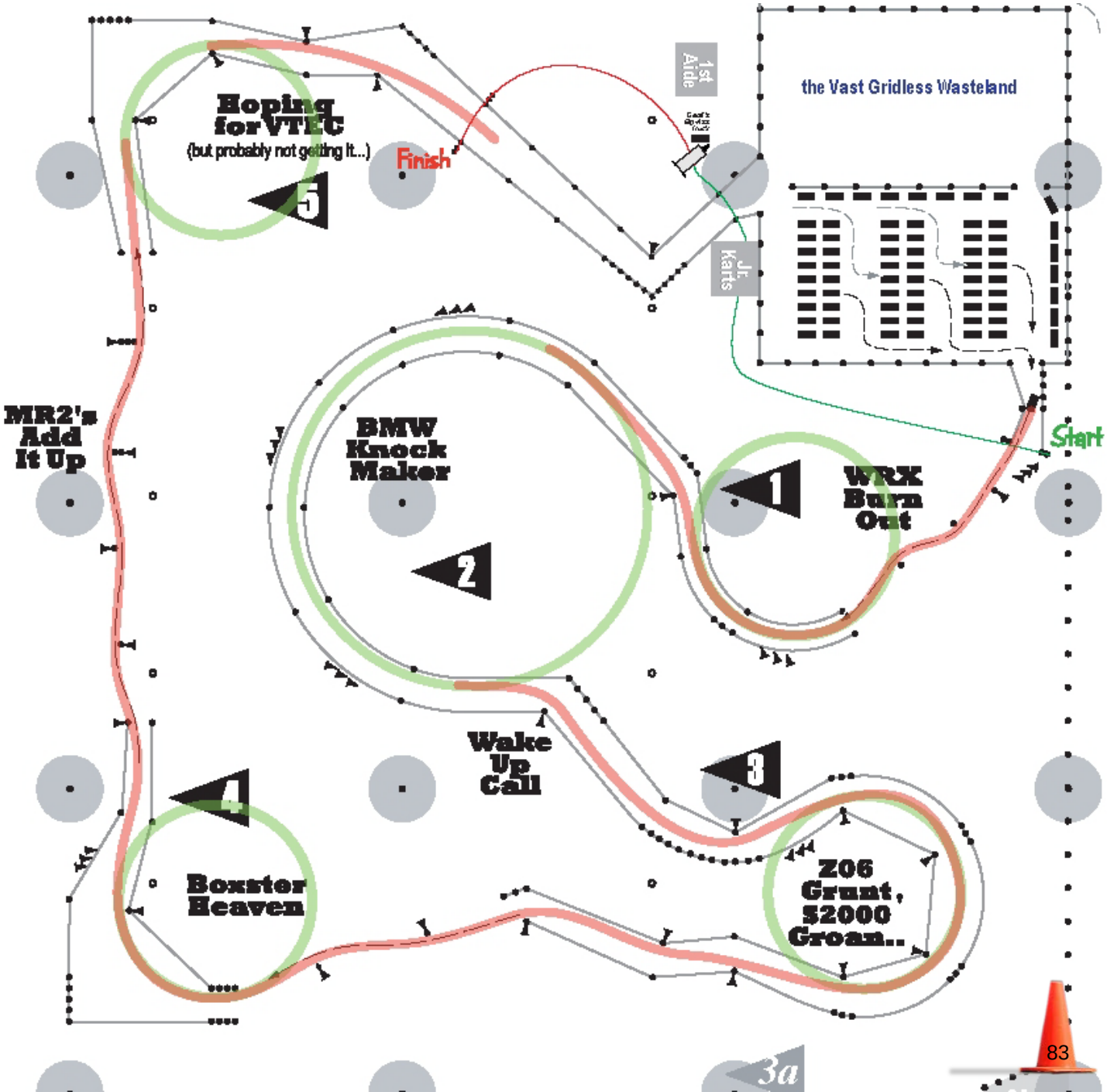
Lateral Gs	Radius of Turn in Feet																
	20	30	40	50	60	70	80	90	100	125	150	175	200	250	300	350	400
1.10	18	22	26	29	31	34	36	38	41	45	50	54	57	64	70	76	81

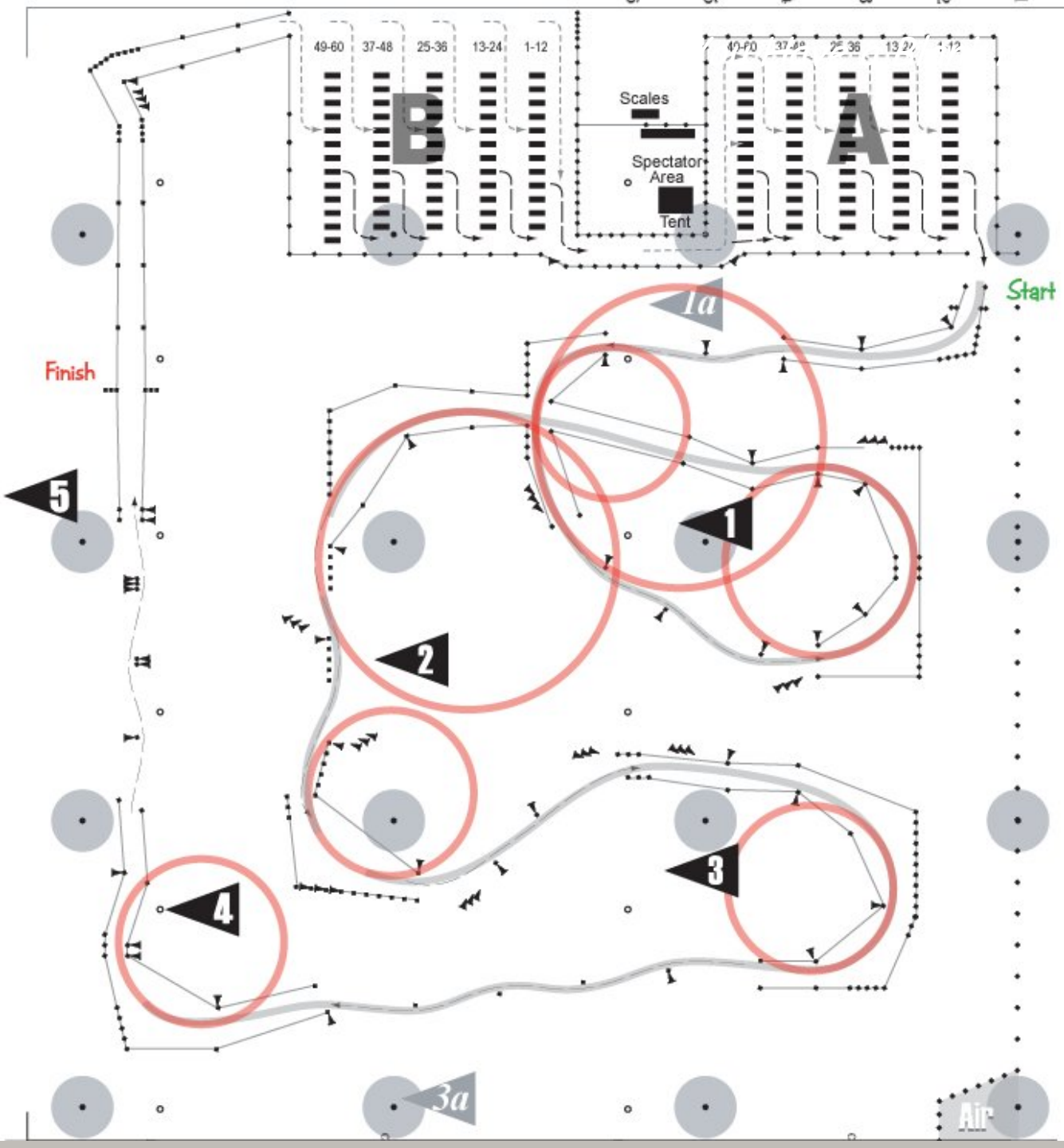
- **Be sure to add plenty of margin to the actual stop box so that all cars can easily slow/stop within the box**
  - 150' brake + 50' reaction time = 200' stop box
  - In addition, when raining, these stop distances increase considerably (about double)

Flow Analysis



Bezier curve analysis helps to plan a fast line through sections that look slow, as well as discover sections that look fast but are truly painful





Pits
(between course and road)

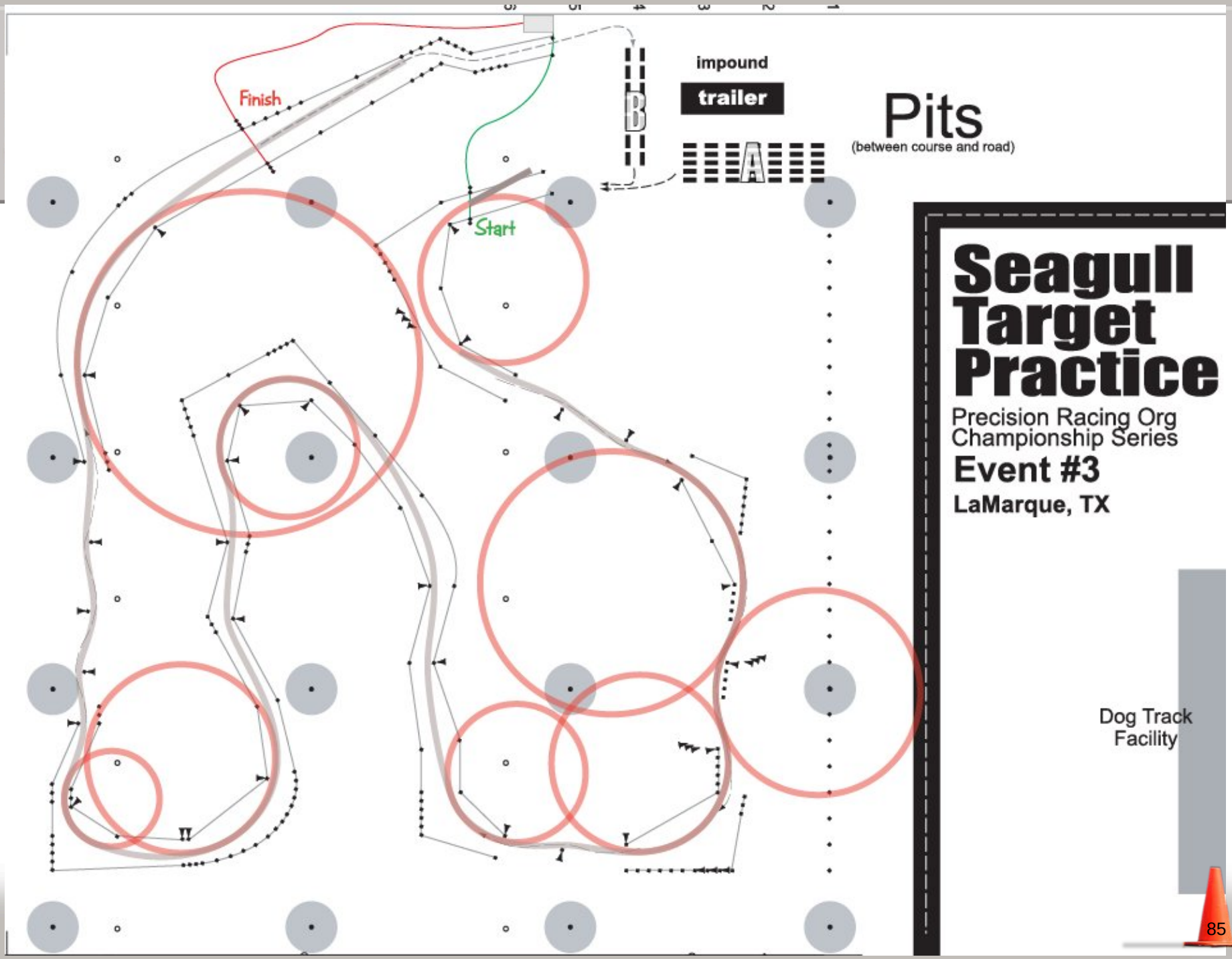
The Houston Region SCCA Proudly Presents:

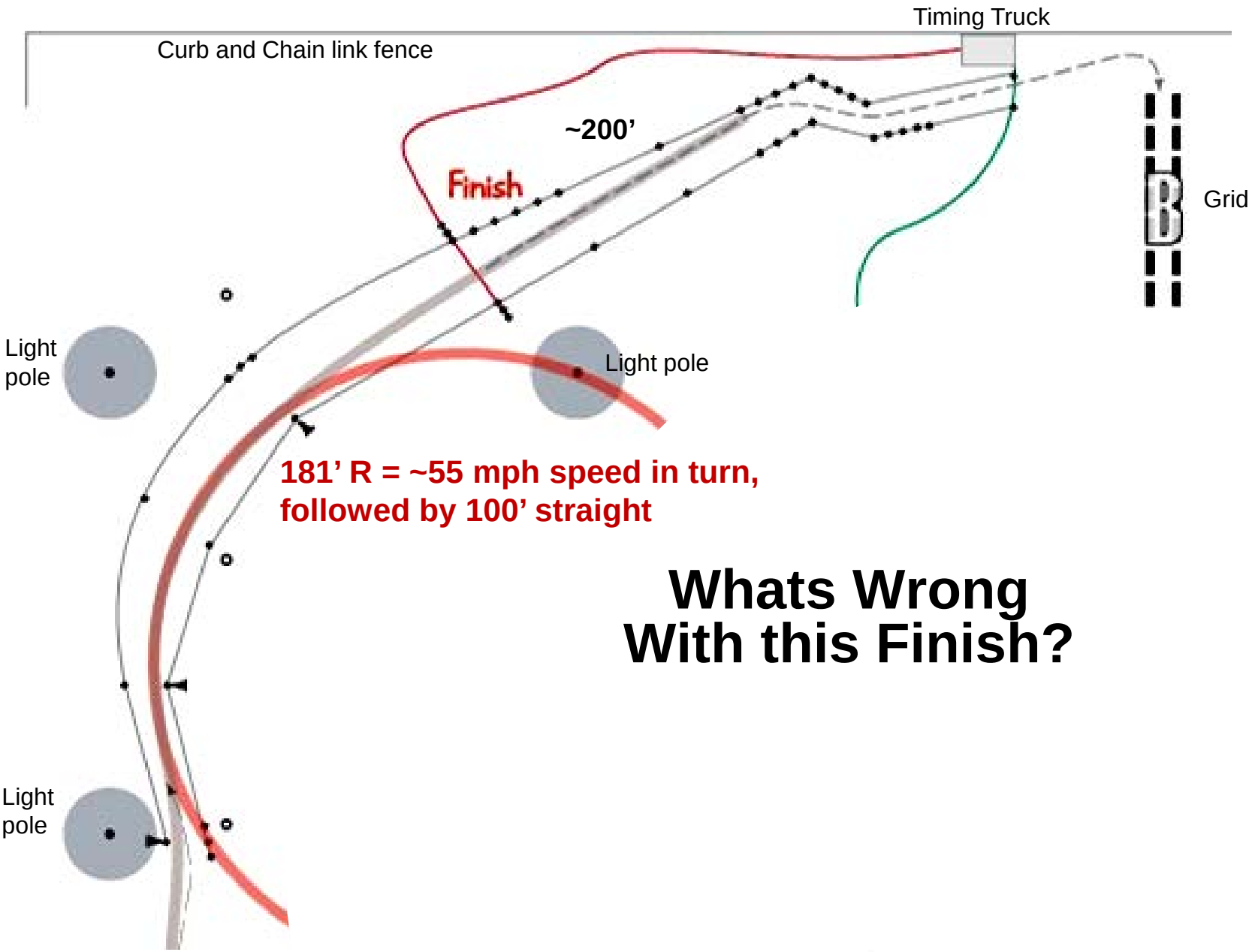
Texas Seagull Target Practice

Day 1

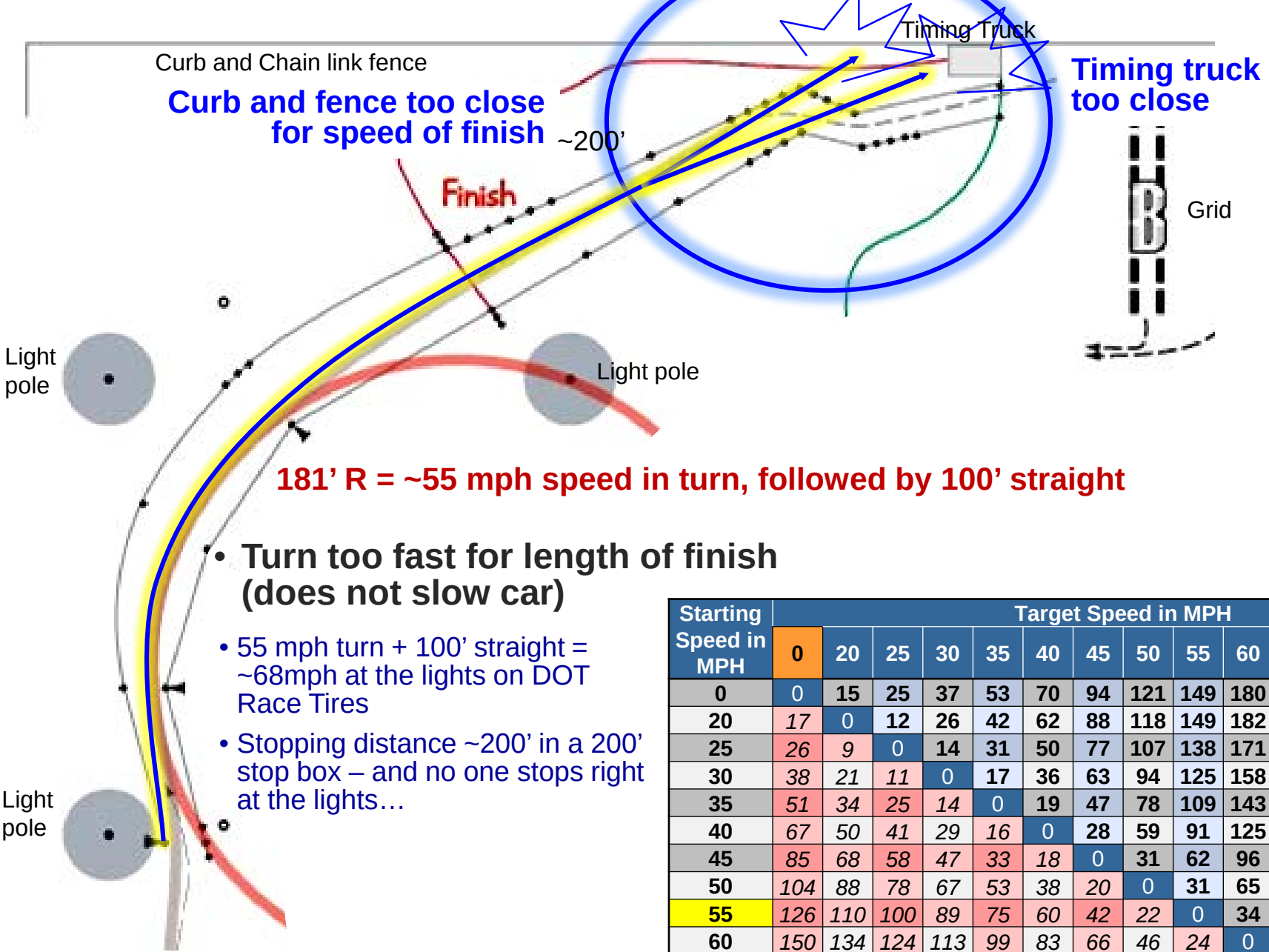
designed by Roger Johnson

Dog Track Facility


Finish
Start
impound
trailer
B
A
Pits
(between course and road)
Seagull Target Practice
Precision Racing Org Championship Series
Event #3
LaMarque, TX
Dog Track Facility



Whats Wrong With this Finish?



181' R = ~55 mph speed in turn, followed by 100' straight

- **Turn too fast for length of finish (does not slow car)**
  - 55 mph turn + 100' straight = ~68mph at the lights on DOT Race Tires
  - Stopping distance ~200' in a 200' stop box – and no one stops right at the lights…

Starting Speed in MPH	Target Speed in MPH												
	0	20	25	30	35	40	45	50	55	60	65	70	75
0	0	15	25	37	53	70	94	121	149	180	222	267	31
20	17	0	12	26	42	62	88	118	149	182	228	277	33
25	26	9	0	14	31	50	77	107	138	171	218	268	33
30	38	21	11	0	17	36	63	94	125	158	206	257	32
35	51	34	25	14	0	19	47	78	109	143	191	243	30
40	67	50	41	29	16	0	28	59	91	125	173	226	29
45	85	68	58	47	33	18	0	31	62	96	145	198	26
50	104	88	78	67	53	38	20	0	31	65	114	167	23
55	126	110	100	89	75	60	42	22	0	34	84	138	20
60	150	134	124	113	99	83	66	46	24	0	50	105	17
65	176	160	150	139	125	110	92	72	50	26	0	54	12
70	205	188	179	167	153	138	120	100	78	54	28	0	69
75	235	218	209	197	184	168	150	130	109	85	58	30	0
80	267	251	241	230	216	200	183	163	141	117	91	63	32

Designing a Safe Finish

No Simple Solution

- **Every change you make - will impact somewhere else**
- **Humans can be totally unpredictable**
  - So **plan** the finish carefully
    - Each site offers its own strengths/weaknesses, and finishes are too often **afterthoughts** rather than well-planned
    - Ensure **adequate room** for runout, ingress, egress, timing, and all of the other associated issues
- **Some of the things that often don't work to control finish speed:**
  - **Tight slalom** right before the finish lights
  - Finish lights **near** exit of **decreasing-radius turn**
- **Some of the things that often do work:**
  - **90 or sharper** turn before *a straight to lig*hts
  - Moderate **slalom** before *a straight to lights*
  - **S-turn sequence** before *a straight to lights*

So You Have a Blank Piece of Paper

Designing a Safe Finish

Consider Human Nature

(stupid humans!)

- **Allow them to "FLOOR IT" at the finish**
  - Most drivers tend to **floor at the finish** in an effort to make up for ALL of the mistakes made up to that point – even if the **design does not allow for it**
  - Since they will do it anyway, (site size allowing) provide opportunity to floor it **SAFELY**
- **How can entrants floor it at the finish safely?**
  - By making them **slow enough** at the point they begin to floor it for the finish
  - In addition, the **car MUST be settled** when floored or you get a high speed spin
  - The **turn preceding** the straight before the lights must be ***completed*** (meaning the car is settled and not wagging) ~100' from the lights
- **Make it safe for everyone by planning for the "unintended line"**
  - Even when the **correct line** ends 100' prior to the lights, will the **wrong approach** end the turn 100' prior to the lights?
    - If not, they will likely be out of control, and flooring it at the finish
  - Walk/drive it **as intended** (on line), and *then* **as not intended** (not on line)
    - The course will look much different when driven not as intended

Designing a Safe Finish

Tweaking it at Set Up

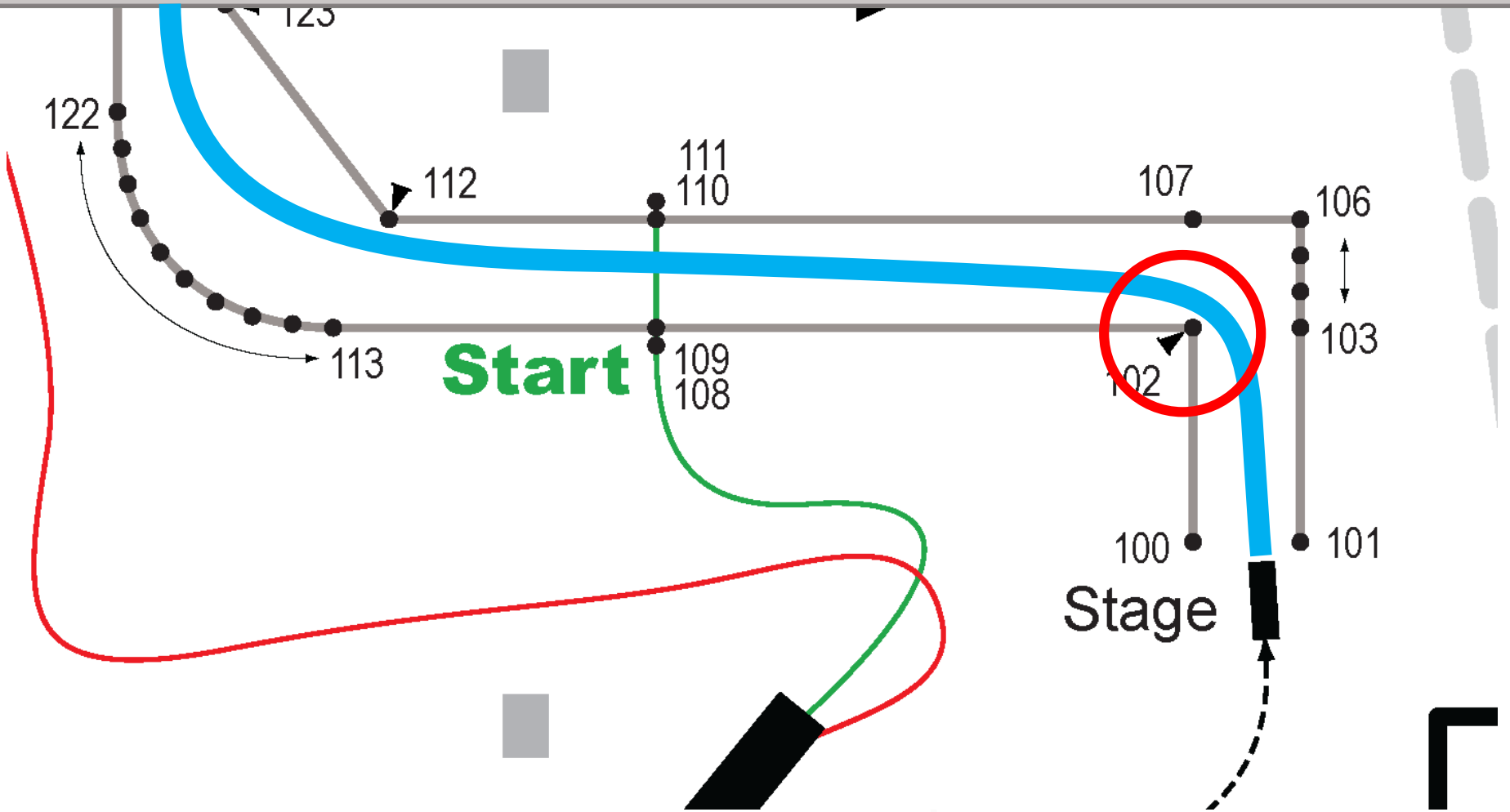
- **Dealing with Acceleration Intoxication**
  - **Impairs** the **driver's judgment** when to safely stop; and nobody brakes at the lights
    - Can result in going **through the end** of the **finish; plan for this**
  - **Define the finish clearly**
    - **Alternately colored cones** after the finish lights; Different **flour line pattern;** Nothing near end of **stop box**
- **Allow enough course area for your finish**
  - Layout the **finish first**, then route the rest of the course to join the start
  - A fast finish should **have 200'; or 250'+** after the lights (refer to speed chart)
  - Long enough to allow stopping with **brakes locked** (not the best way to stop)
  - **Ample buffer** after the end of the finish lane (faster = more buffer – 75' minimum)
- **Make it safe for everyone by planning for the "unintended line"**
  - Test drive it **as intended** (on line), and *then* **as not intended** (not on line)
    - The course will look much different when driven not as intended

Designing a Safe Finish
Checklist

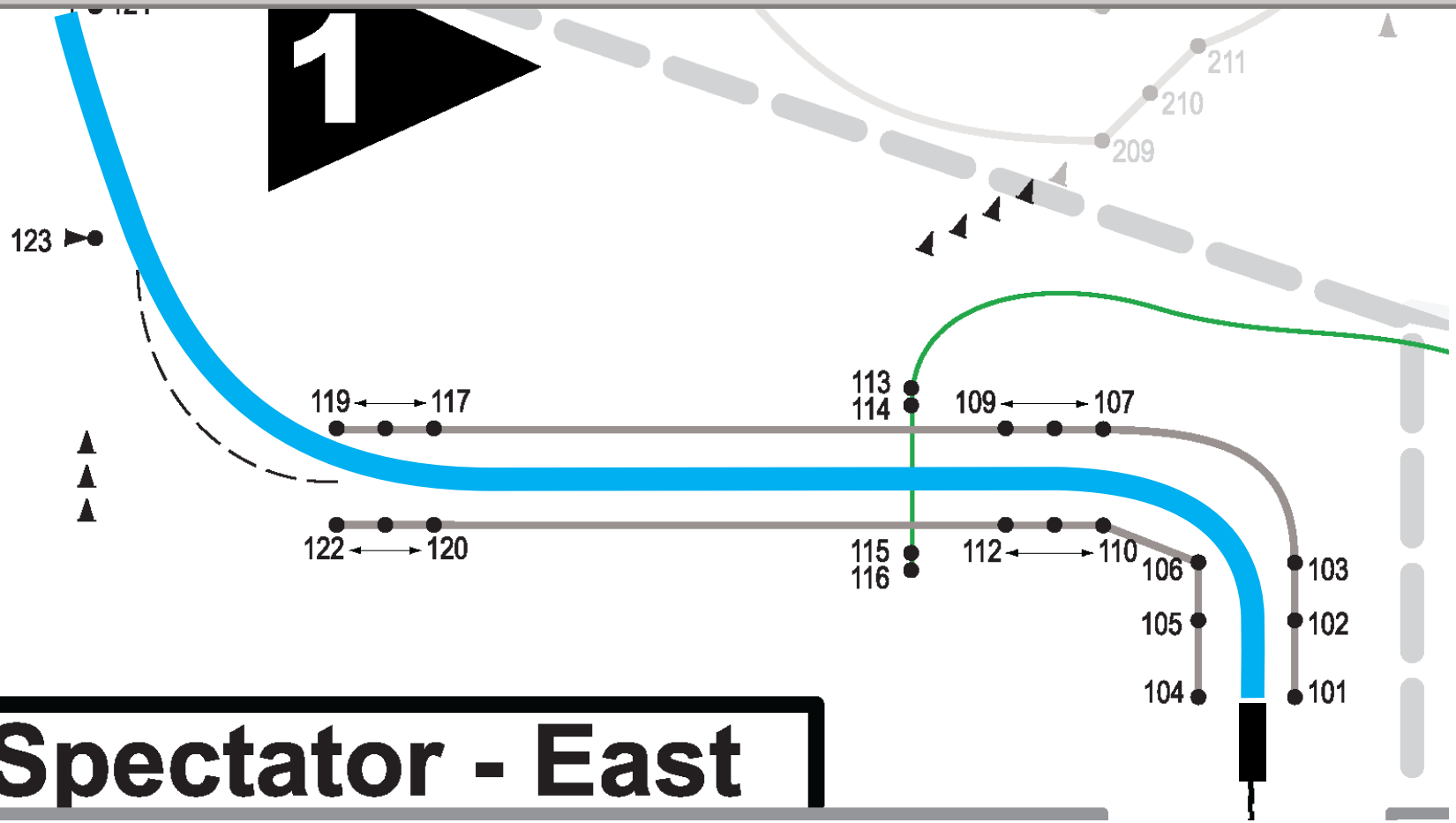
- **In summary, a safe finish:**
  - 1.) Allows enough course area to **stop easily**
  - 2.) Allows the entrant to "**floor it**" on the **last 100'** to the finish - **SAFELY**
  - 3.) Includes a **slowing turn** that is completed **before** the 100', even if **driven incorrectly**
  - 4.) Has considered and been revised for the "**unintended line**"
  - 5.) Considers what lies **beyond the finish lane**
  - 6.) Does **NOT** depend on **common sense** to prevent an incident
- **Words of wisdom**
  - If **course length has to be given up** to provide enough run out after the lights, so be it
    - It will only cost about a second to give another 50-70 feet to the finish
  - Make sure the "**slowing turn**" to rein in speeds before the finish, **actually slows**
  - It's better to have **folks grumble** about slower speeds than it is to **have an incident**

Starts and Finishes

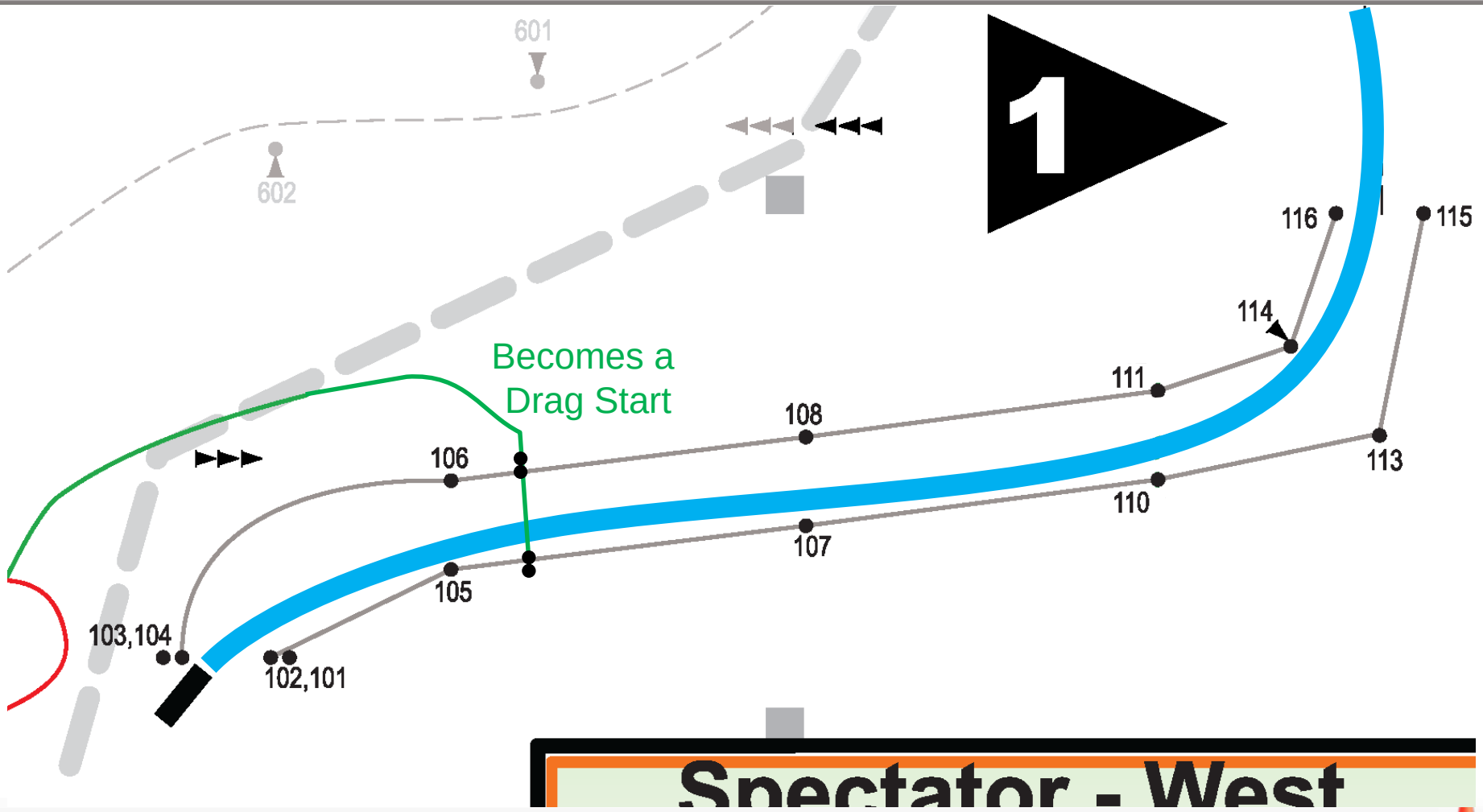
Turn Before



Starts and Finishes
Turn Before

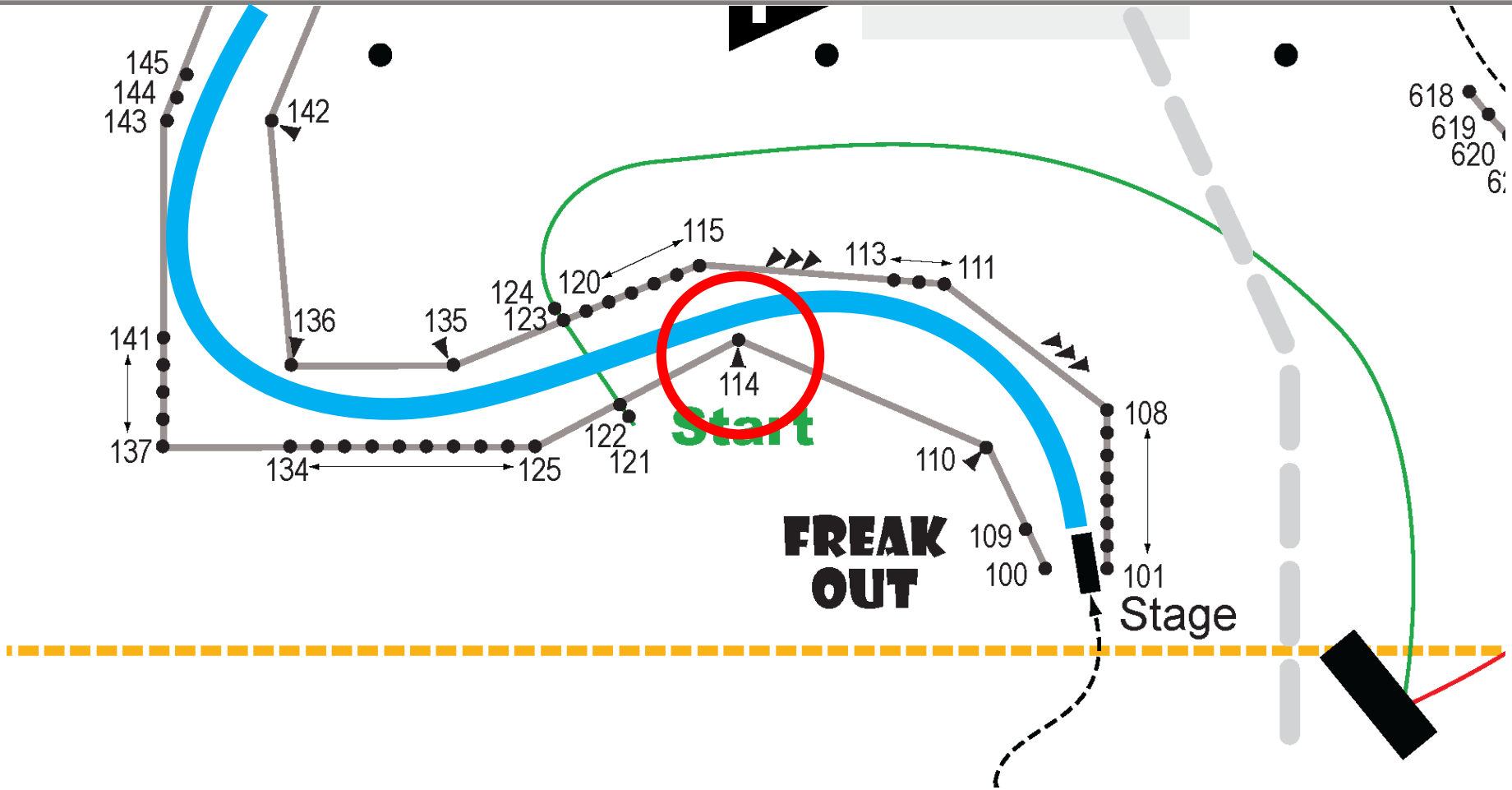


Starts and Finishes
Turn After



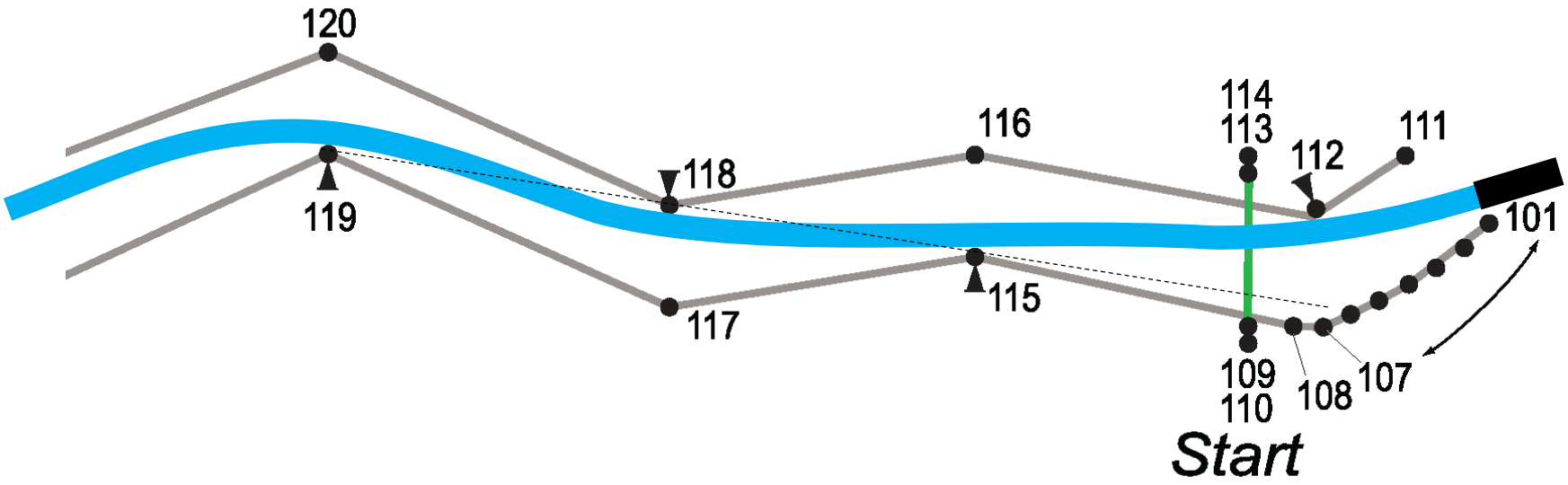
Starts and Finishes

Turn Before and After the Lights



Starts and Finishes

Effectively a Drag Race Start



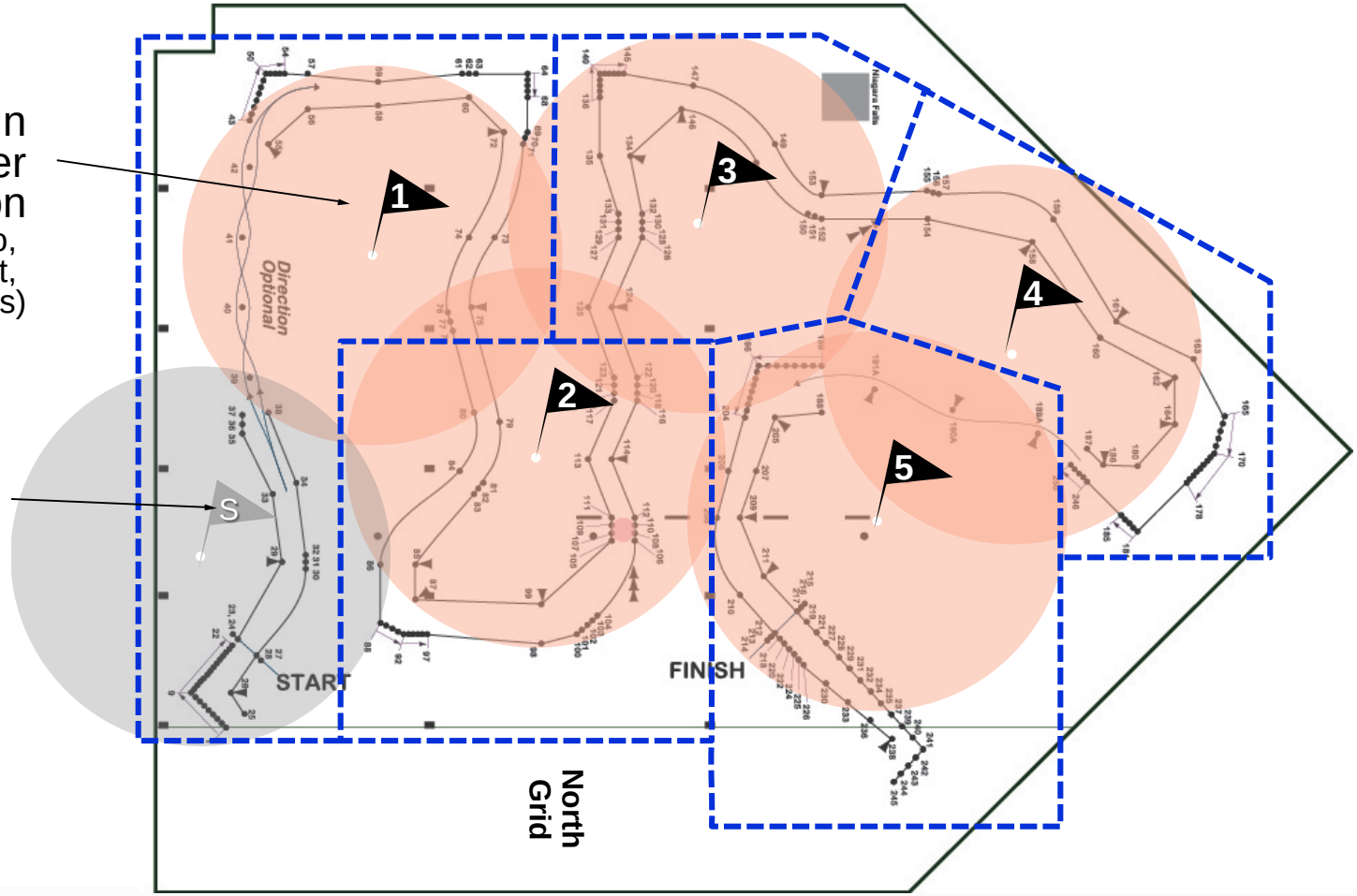
Worker Stations

- **Now add the projected course worker stations and projected coverage area**
  - Keep coverage distances around **200 feet** in any direction or less if possible
  - Position near **solid objects** if possible/available
    - light pole
    - tree
    - planter, etc.
  - Locate workers on the **inside of a turn** rather than the outside
  - Anticipate possible directions that a **car may spin** and avoid those areas
  - Prioritize closeness to the **cones likely to be hit**
    - slalom cones
    - tight apexes
    - outside walls at ends of significant straights, etc.
  - Try to ensure that workers do not have to **cross another area of the course** to get to a down cone in their coverage area

Placing Worker Stations

Main Worker Station (Radio, Audit Sheet, Cone Chasers)

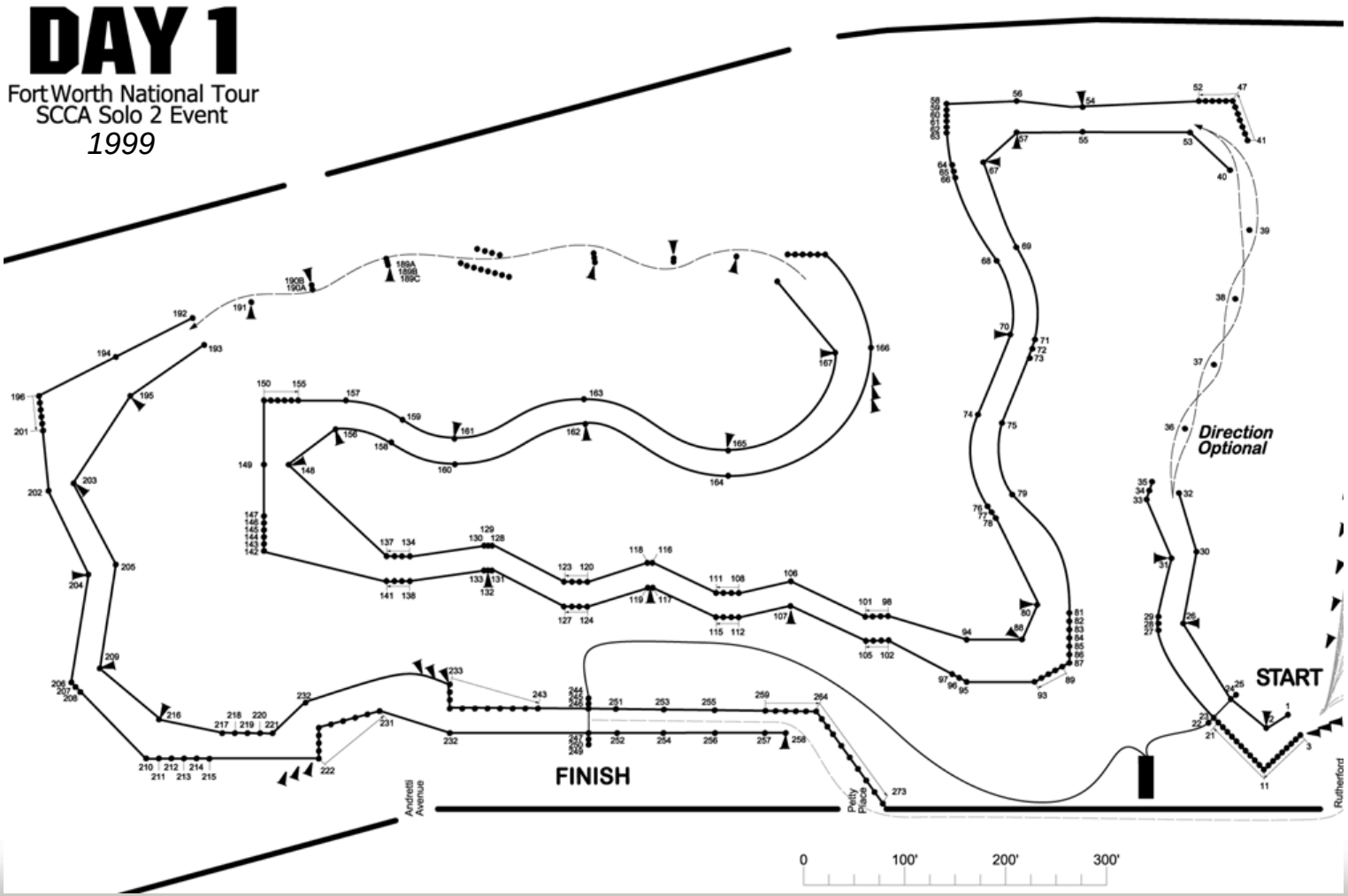
Satellite Worker Position (1 or 2 Cone Chasers)



Course Set Up at the Event Site

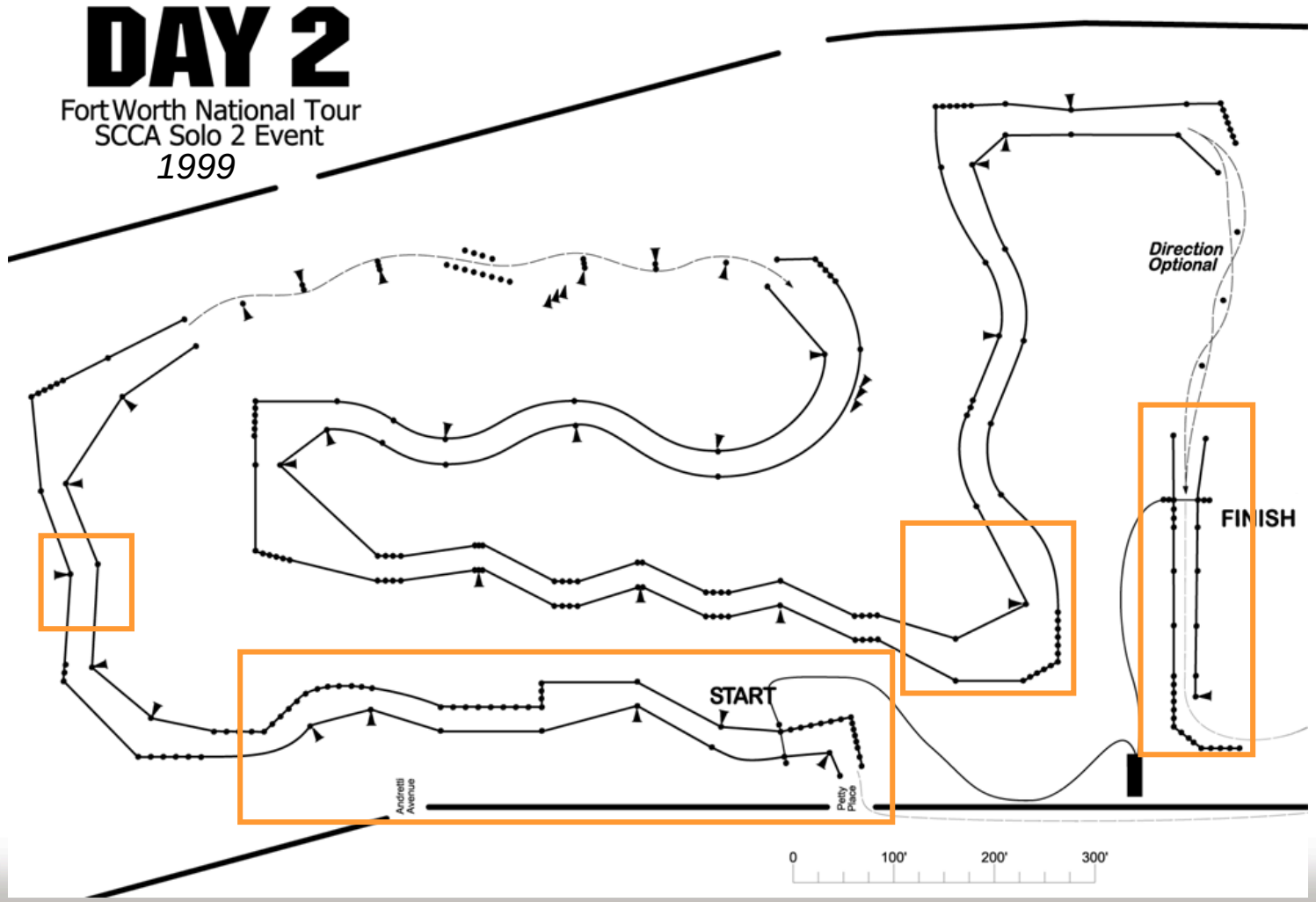
- **Things are not always what they seem - or - I could have sworn they'd have to lift there!**
  - It is rare to be able to say that the entire design **worked the way it was intended**
    - The 1995 Nationals course shown earlier turned out to be **flat out from the start** until the first 90° turn - not what I expected at all!
  - Sometimes it is **difficult to spot poor sections on paper** but easy to see once the pylons are in place
    - A good designer will **exhibit flexibility** and make **on-site adjustments** to allow the course to flow properly
      - Maps, such as the ones included in this booklet, usually have cones in them that are approximately **3-5 feet in diameter** - which makes it impossible to be totally accurate
      - Because of this, some course elements which appear to reduce speed on paper **may in fact be wide open**, as I found out from my example above
      - The converse is true too - some elements which appear to be moderately open will be **difficult and tight to drive**
- **So make adjustments at the event site, make note of your errors and your current and future course designs will benefit**

Large, Expansive Sites



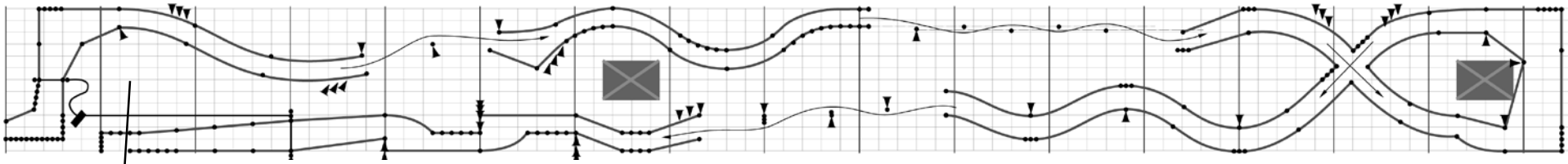
So You Have a Blank Piece of Paper

Large, Expansive Sites
(continued)



- Differences between Day1 and 2 besides course direction

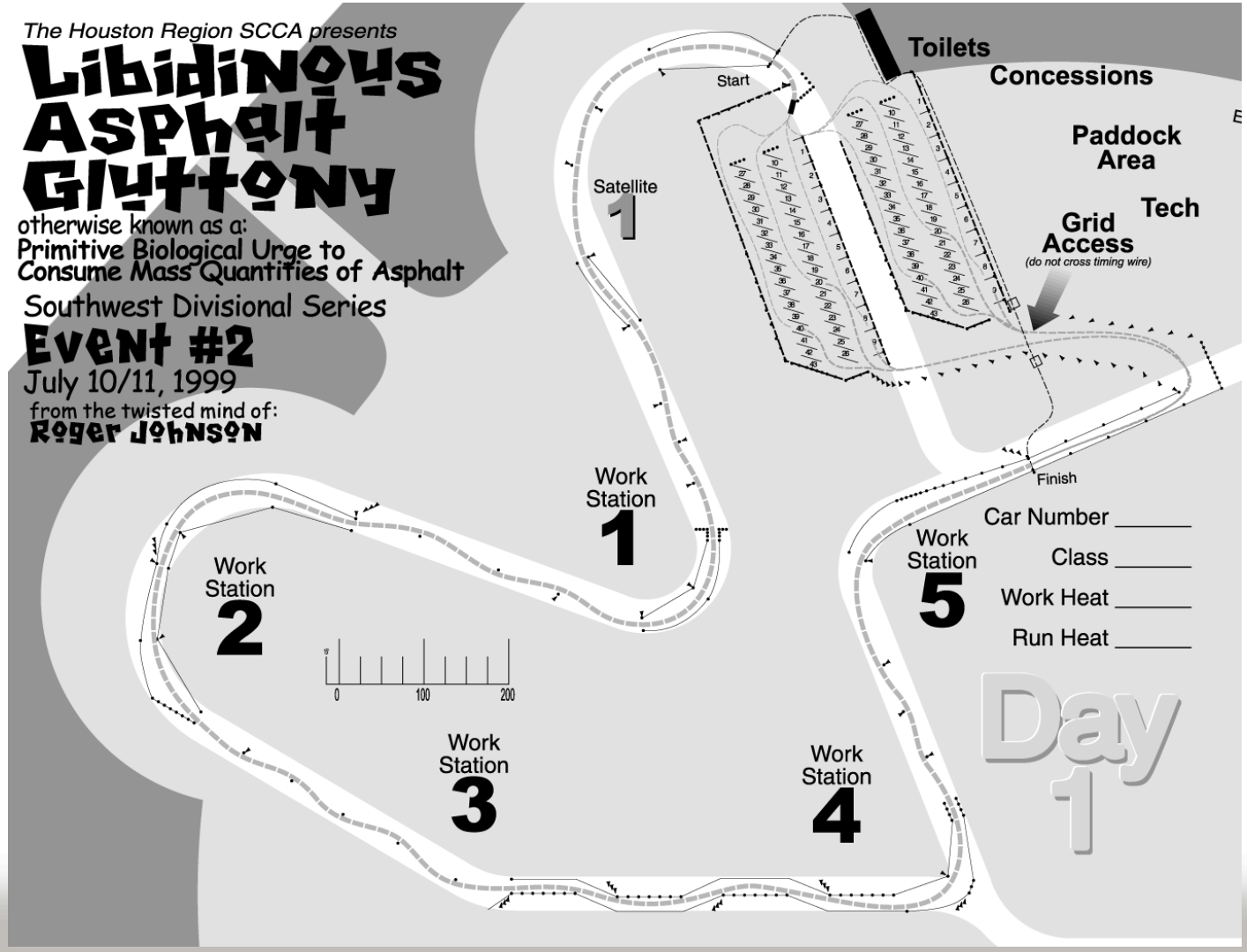
Long Skinny Sites



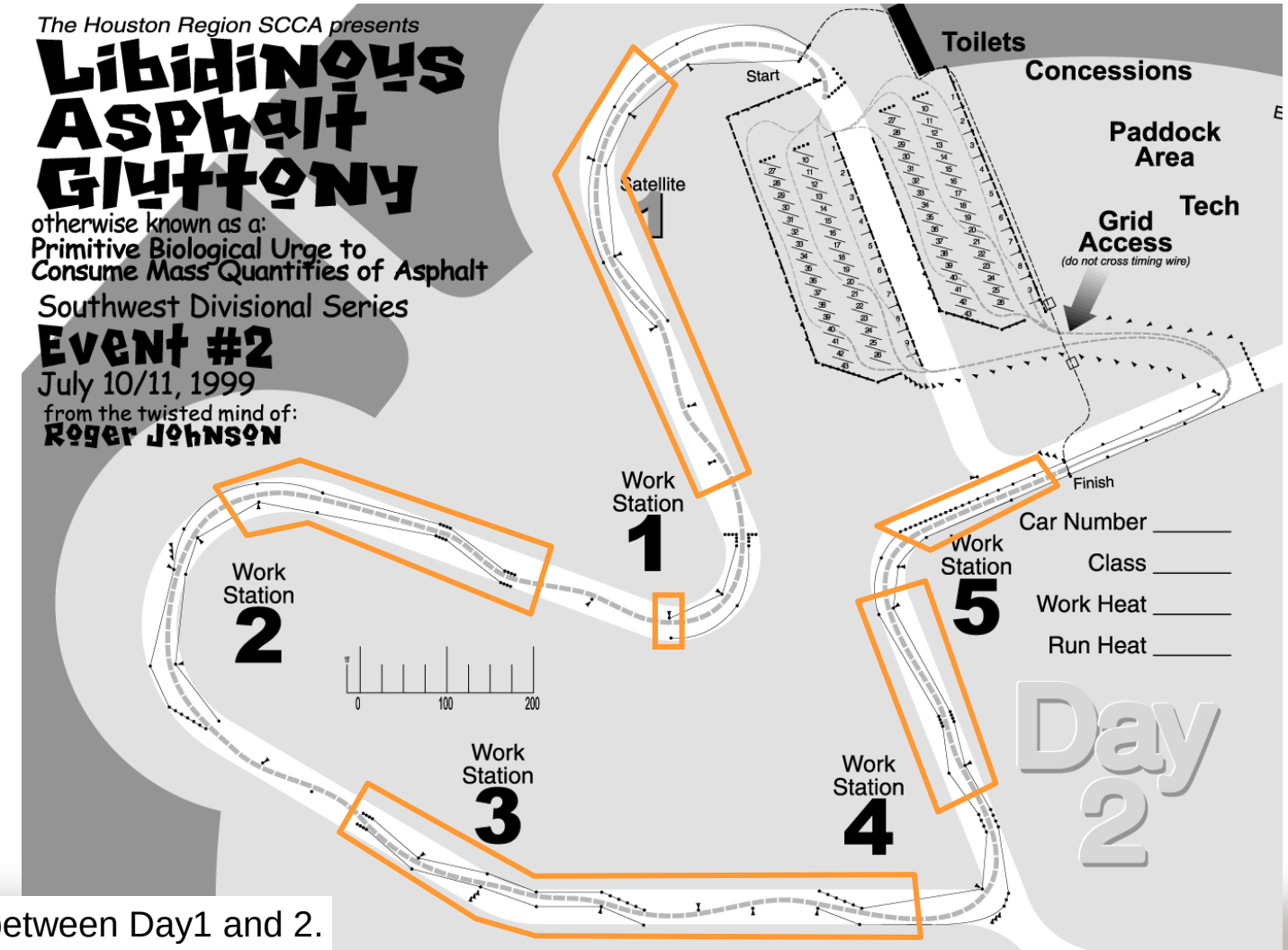
12.5 x 15 grid
(Cement Squares)
150’ wide

- **How about a “long and skinny” event site?**
  - Avoid slalom down, 180° turn, slalom back
  - Balance between slaloms, sweeping turns, and offset gates, just as you would in an open lot
  - You just have to be more creative to do so… 8^)

Narrow Road Course Sites



Narrow Road Course Sites
(continued)

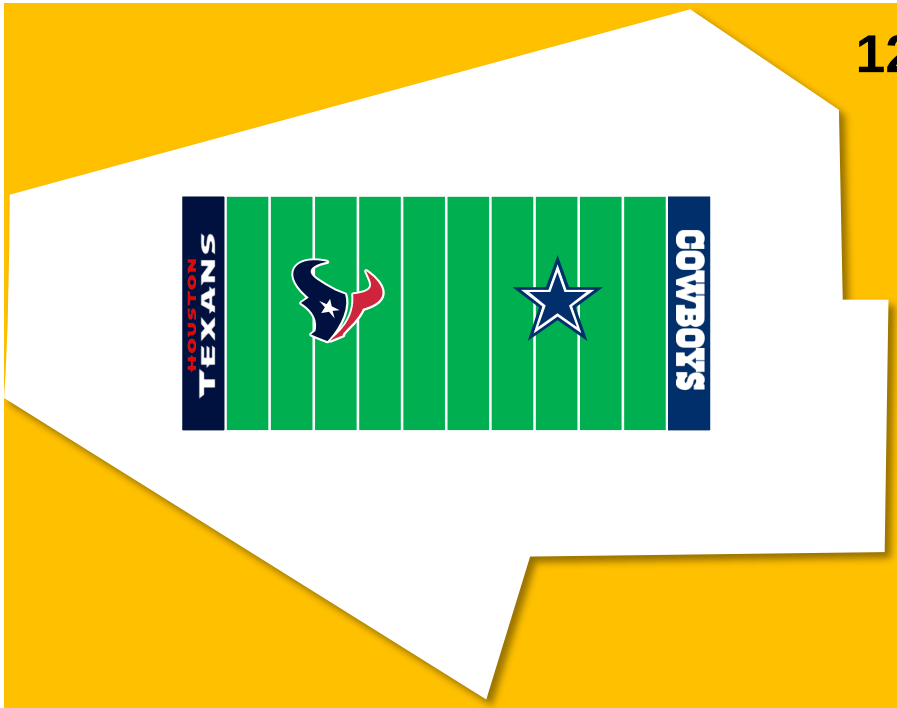


- Differences between Day1 and 2.
  Note that course direction is same both days

So You Have a Blank Piece of Paper

Small Or Odd Shaped Lot Utilization

Estadio Monumental vs. SCCA Nationals East Course Area

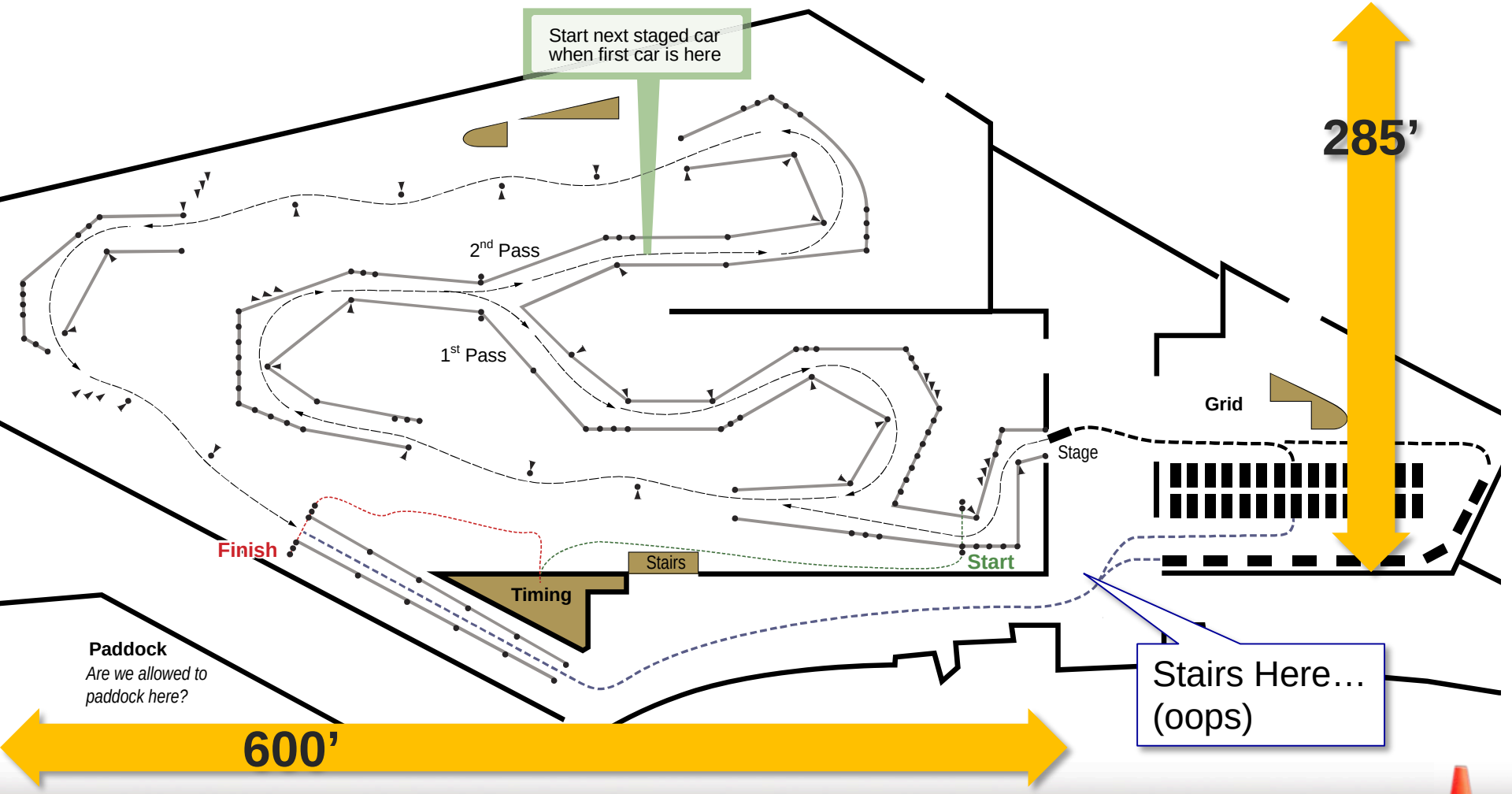


1200’

700’

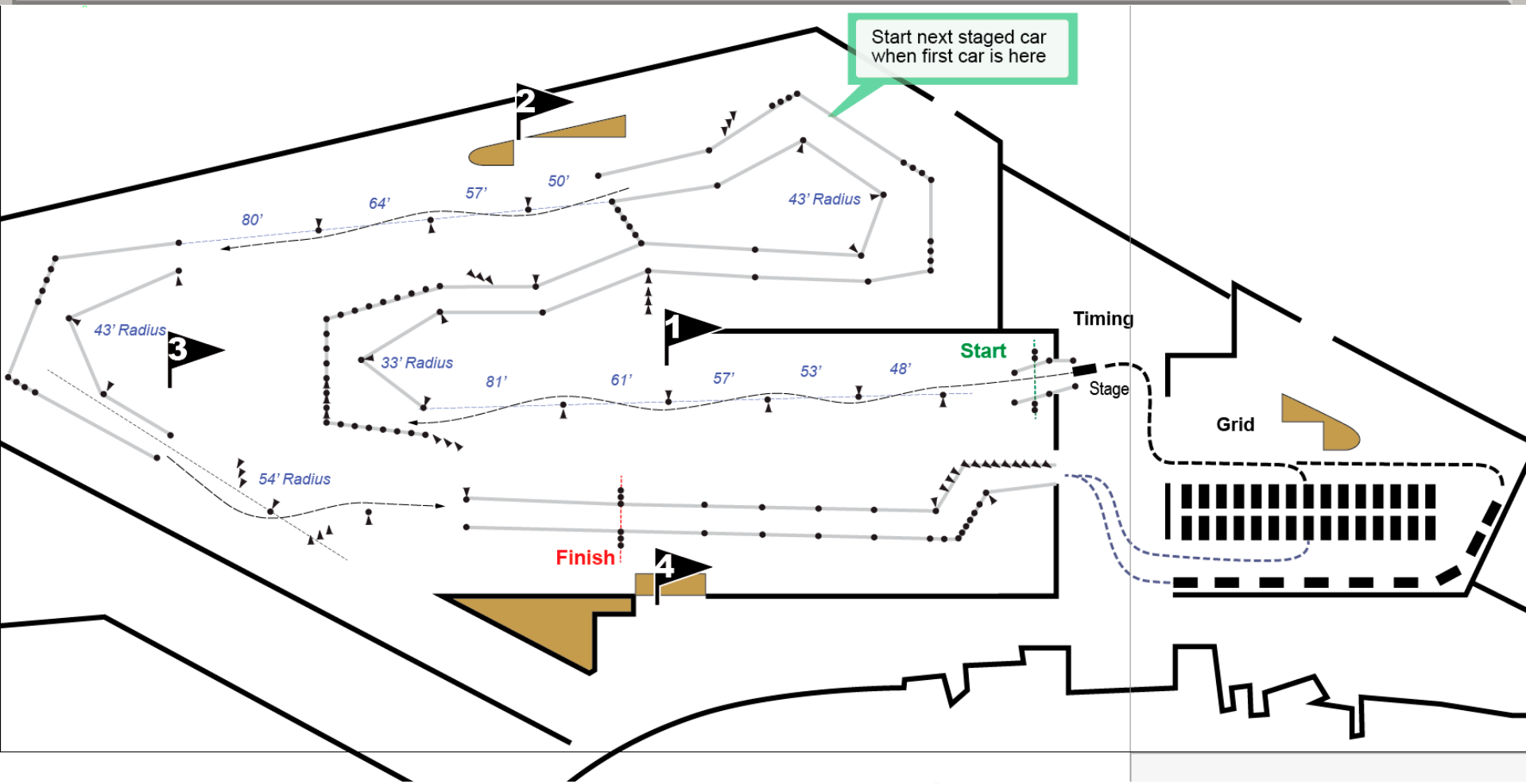
Small Or Odd Shaped Lot Utilization

Estadio Monumental First Try



Small Or Odd Shaped Lot Utilization

Estadio Monumental



Small Or Odd Shaped Lot Utilization

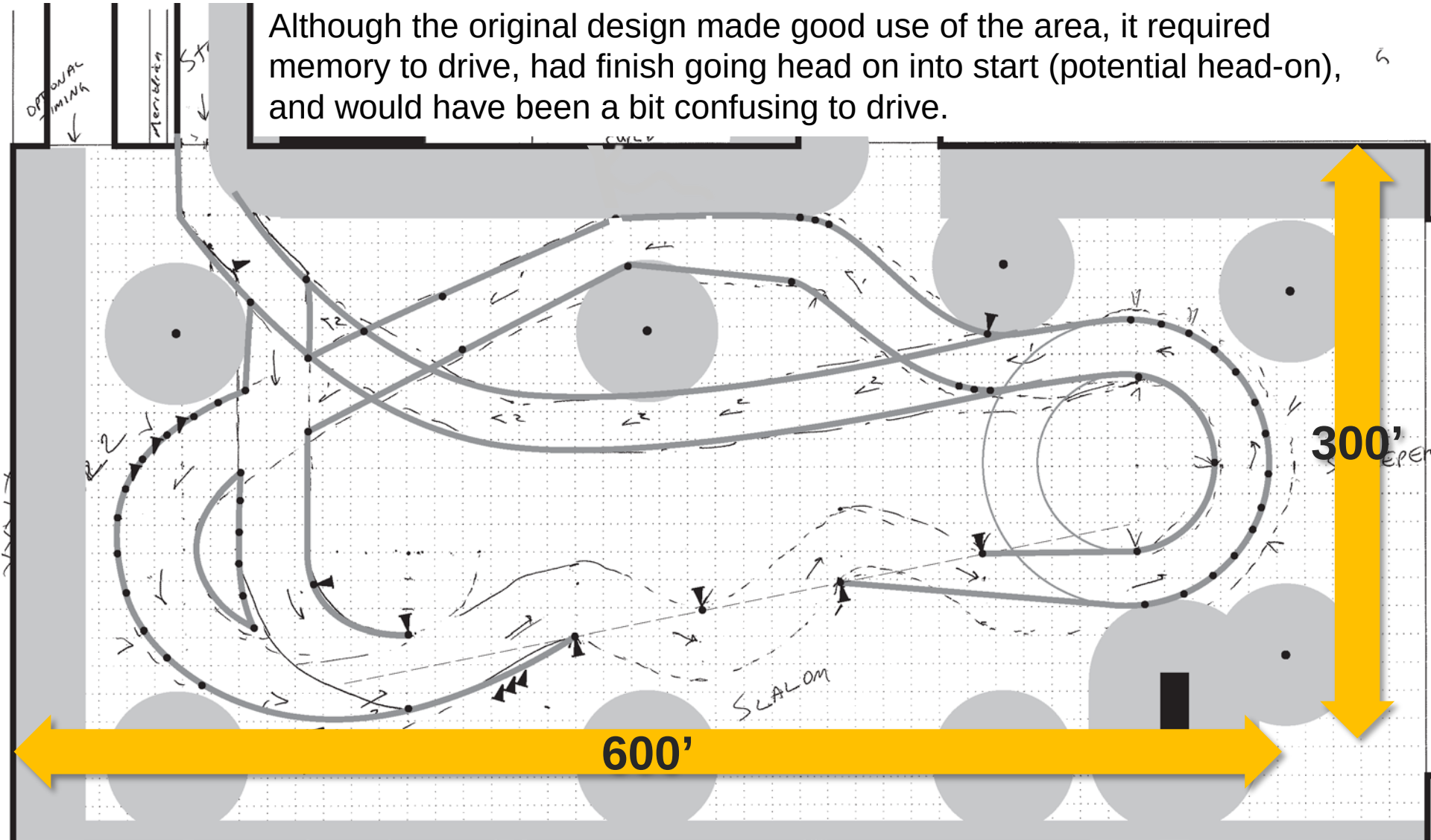
Lumber Yard vs. Solo Nationals East Course Area

So You Have a Blank Piece of Paper

Small Or Odd Shaped Lot Utilization

Lumber Yard Site

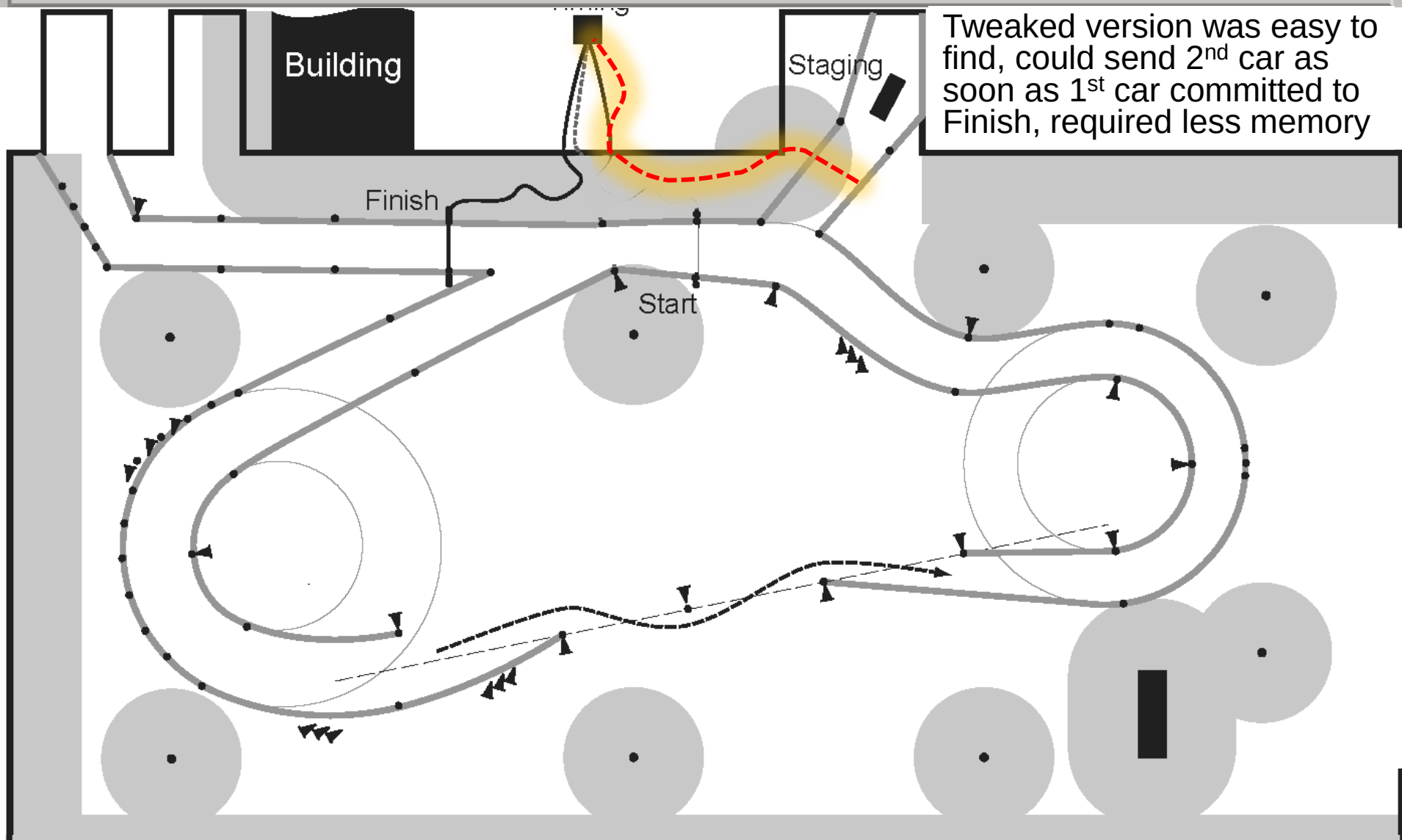
Although the original design made good use of the area, it required memory to drive, had finish going head on into start (potential head-on), and would have been a bit confusing to drive.



So You Have a Blank Piece of Paper

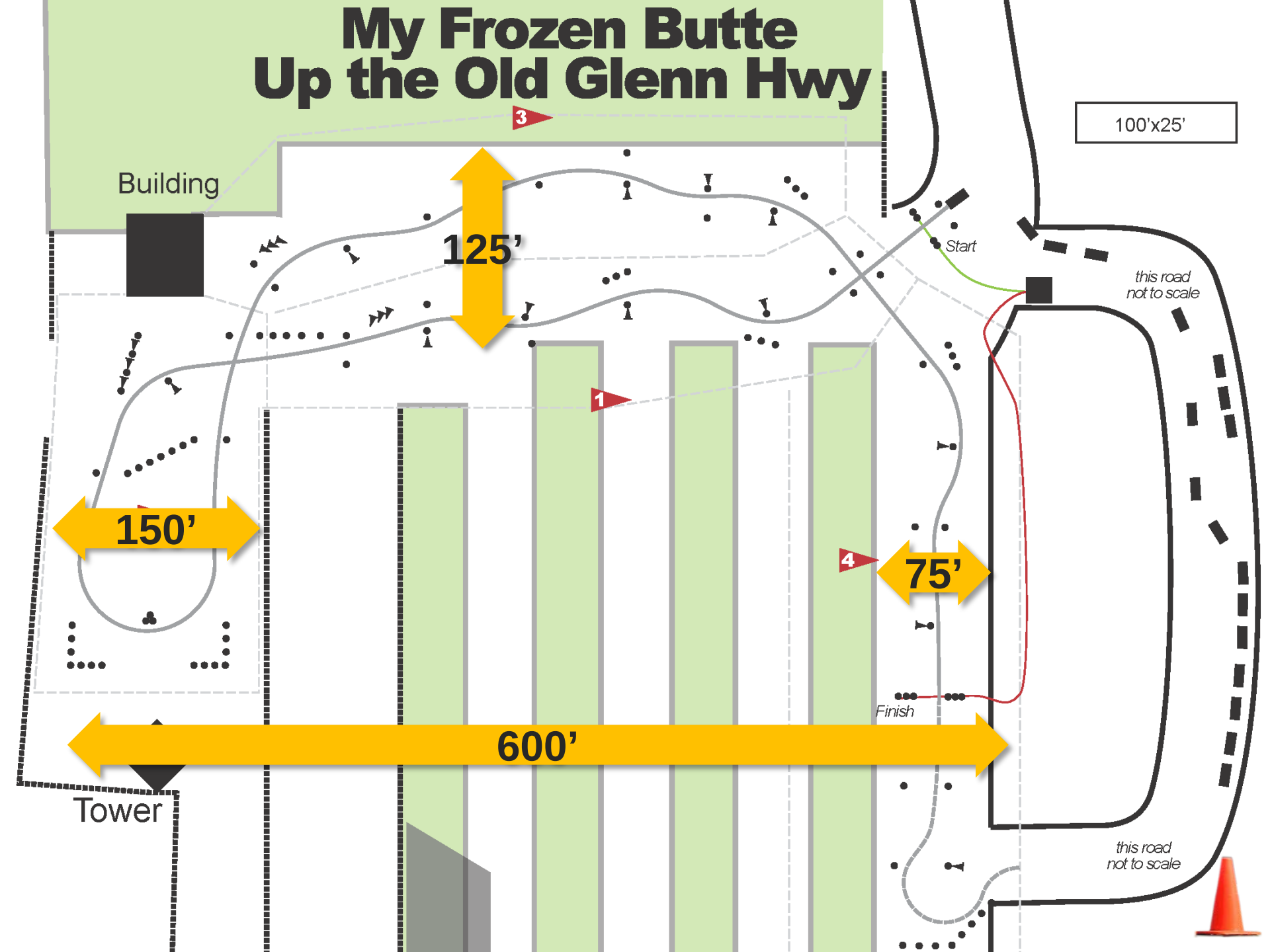
Small Or Odd Shaped Lot Utilization

Lumber Yard Site



Tweaked version was easy to find, could send 2nd car as soon as 1st car committed to Finish, required less memory

My Frozen Butte vs. Solo Nationals East Course Area


My Frozen Butte
Up the Old Glenn Hwy
100'x25'
Building
125'
Start
this road
not to scale
3
1
150'
4
75'
Finish
600'
Tower
this road
not to scale

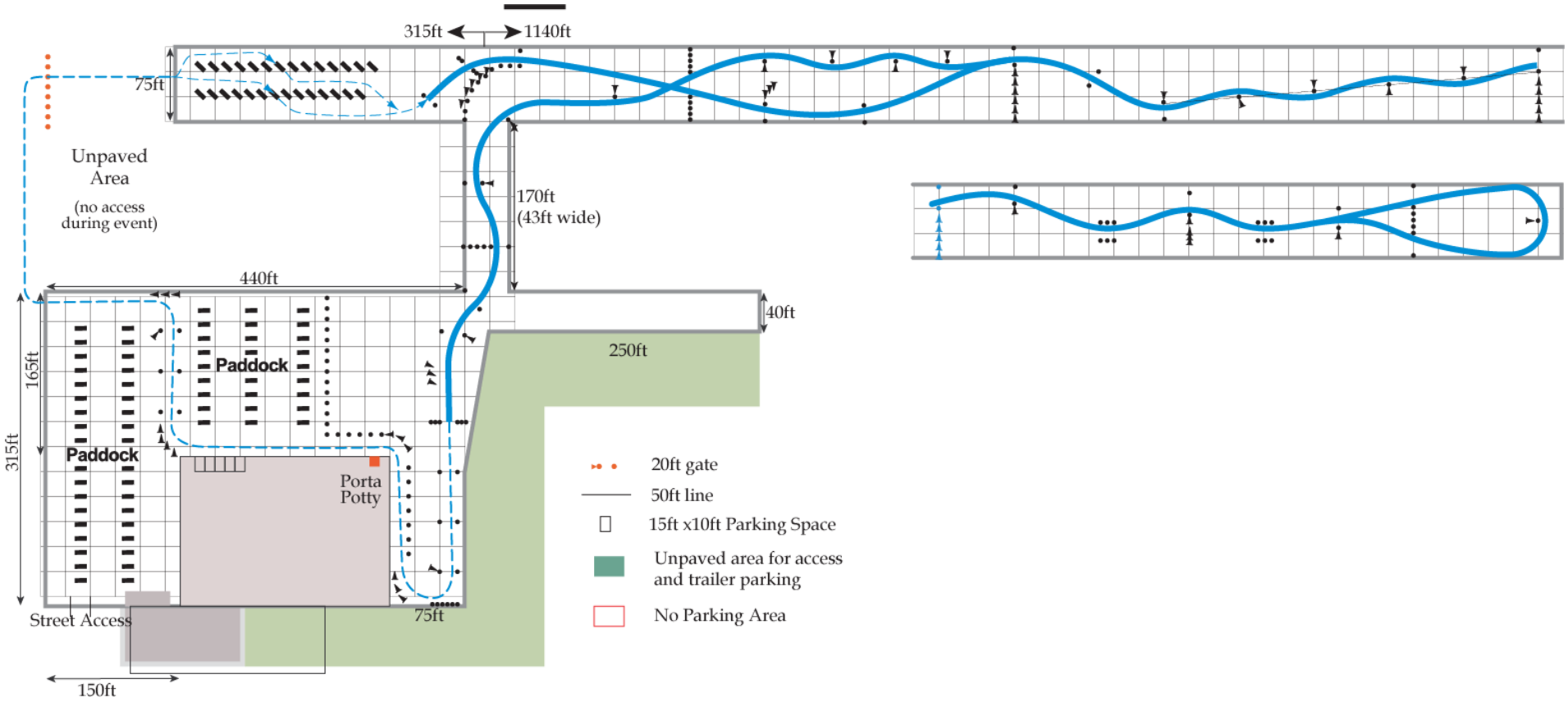
Small Or Odd Shaped Lot Utilization

COTA vs. Solo Nationals East Course Area

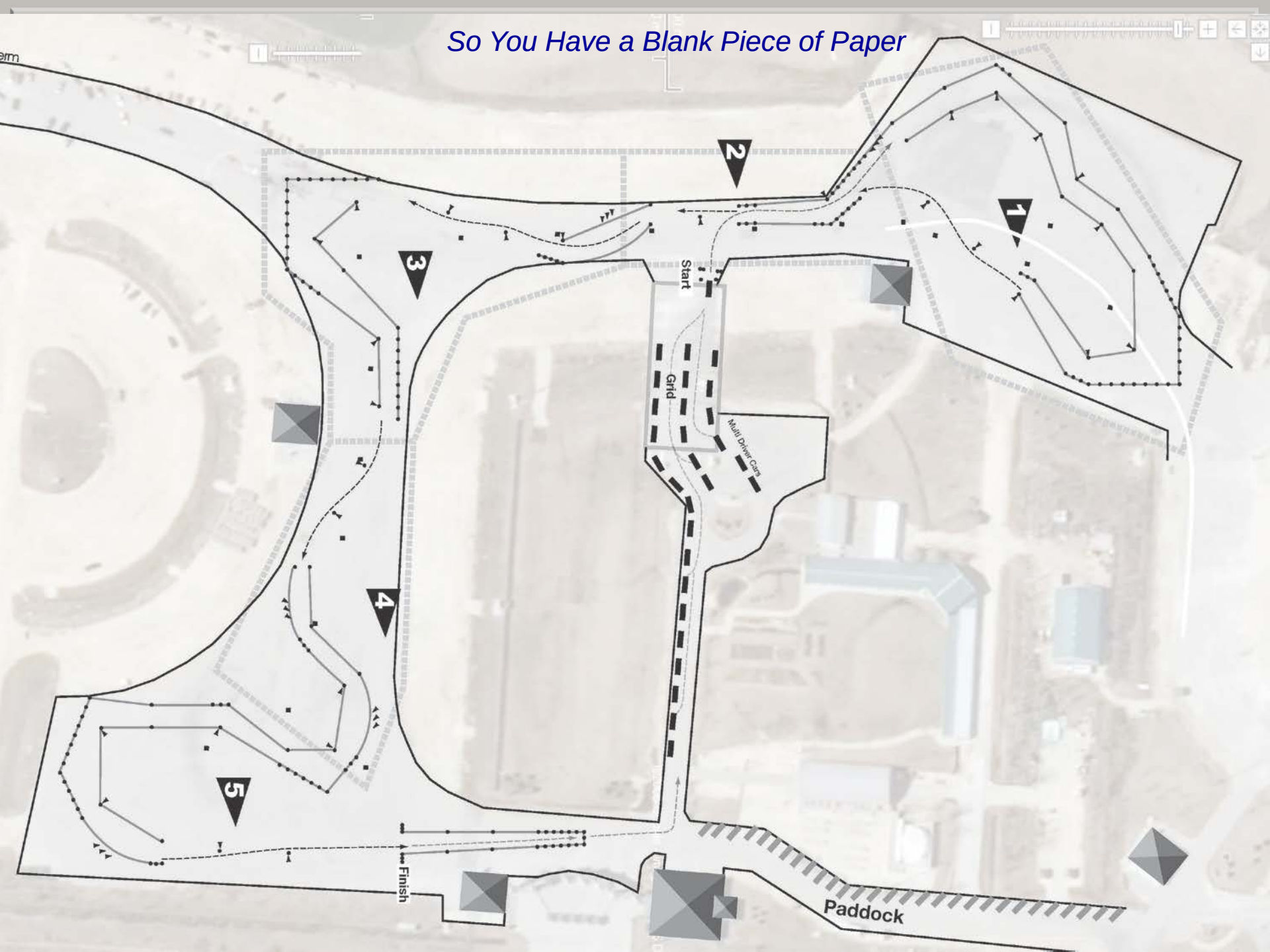
Small Or Odd Shaped Lot Utilization

Circuit of the Americas (COTA)

Other Difficult Shaped Sites

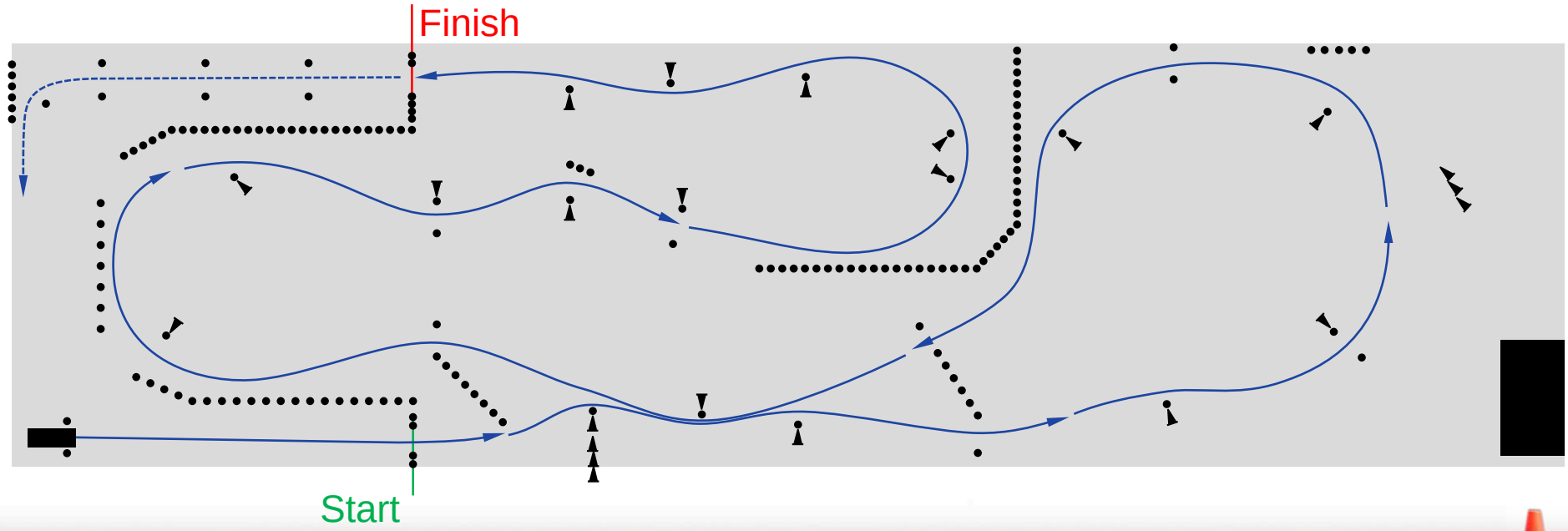


So You Have a Blank Piece of Paper



Useful Tricks for Limited Space

- **Shared walls**
  - Placement may limit to one car at a time
- **Out-and-back through section**
- **Variety through longitudinal spacing**



Despised Elements
Maneuvers to Avoid

- **Any extremely slow maneuver; "technical" and "slow" are not the same thing**
- **360 degree pivot turns - or also known as a spin cone - Ditto for 270 pivots**
- **Narrow, walled in sharp turns with no room for choice of line**
- **Gates or Slaloms with severe offsets and short spacing**
  - i.e. 45' spacing; 10' offset against the driver
- **Two narrow (painful) 90 degree walled in turns (shaped like a "Z") just before the finish lights**
  - Which might be O.K. for a start – but no way to finish **if you don't have to**
- **Hitting the brakes hard just <u>before</u> the lights**

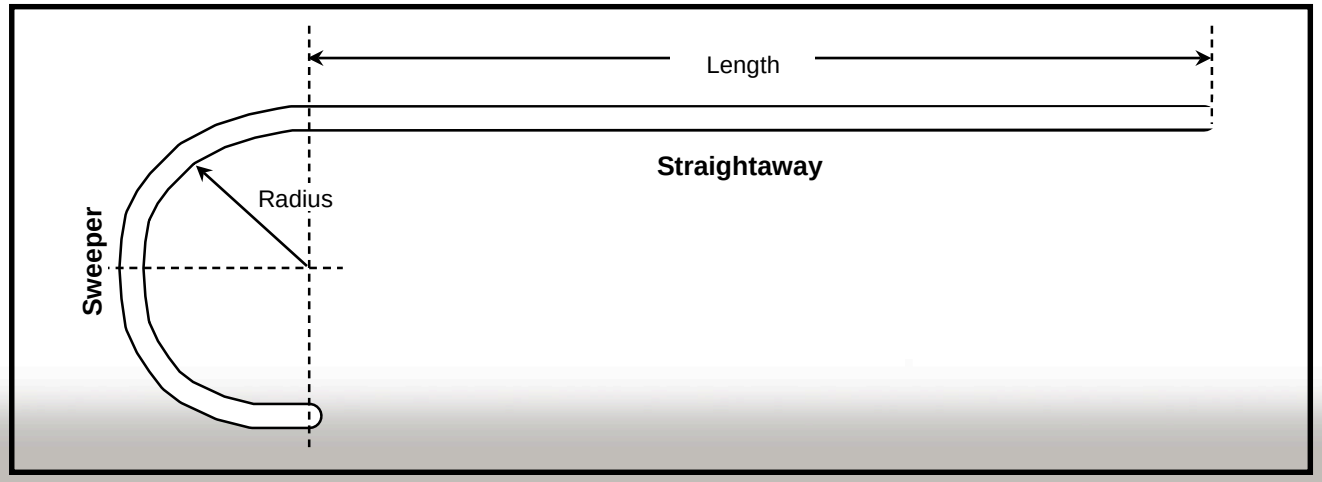
Agenda

- Fundamentals
- 10 Basic Concepts
- So you have a Blank Piece of Paper...
- **Elements, Dimensions and Real Speed**
- Summary and Questions

Element Dimensions and Real Speed

- **This section of the book will address is how you, as a course designer, can relate course content and size to how fast the competitors cars might actually go**
  - You “Techno-Weenies” are gonna love this
  - If you are not a TW, this section is still important to understand. It has a real life example as to why you must make your courses “equalizer courses” as outlined in the 6th basic concept (Horsepower vs. Handling)

- **This section will address:**
  - Sweeper speeds
    - Radius of a turn
    - Cornering G’s of a car
  - Straightway speeds
    - Length of straight
    - Acceleration times

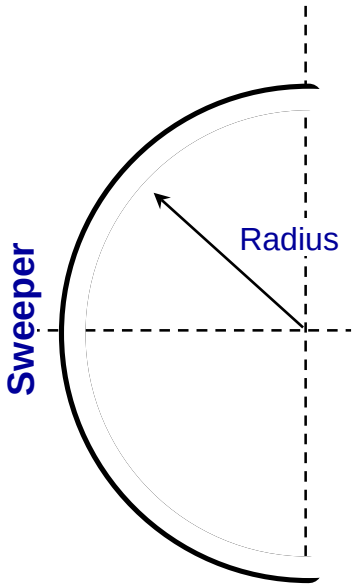


Disclaimers

- **All calculations shown in this section are based on Car magazine road test data**
- **The variables include:**
  - Type of surface used for testing
  - Type and size of the tires on the car
  - Preparation level of the car
    - shocks
    - alignments
    - bushings, etc.
  - Abilities of the test driver
- **Approximations are inherent in the methods used**
  - Sweepers are not usually constant radius arcs
  - Straightways often are not perfectly straight
- **What makes a quick autocross car is not just pulling high G's and acceleration**

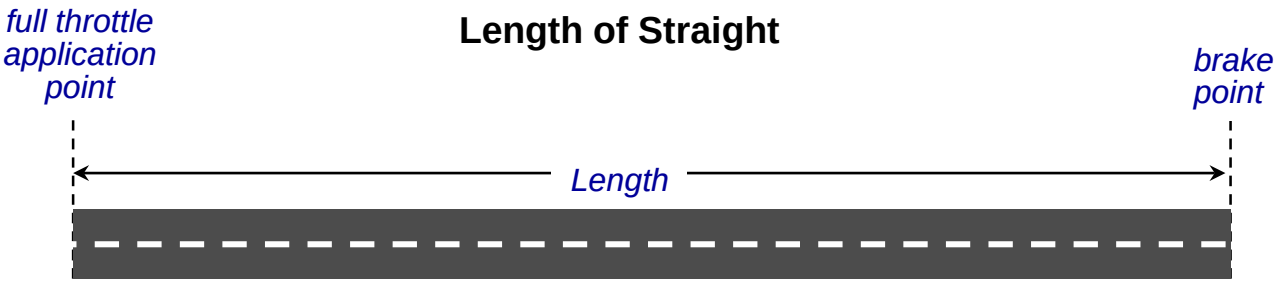
Sweeper Speeds

- **The relationship of the radius of the turn and the cornering G's is shown in the table below:**



G Force	Miles per hour		
	Radius 50'	Radius 75'	Radius 100'
0.90	25.9	31.7	36.6
0.85	25.1	30.8	35.6
0.84 ('93 Camaro)	**25.0**	**30.6**	**35.3**
0.82 ('93 Sentra)	**24.7**	**30.2**	**34.9**
0.80	24.4	29.9	34.5

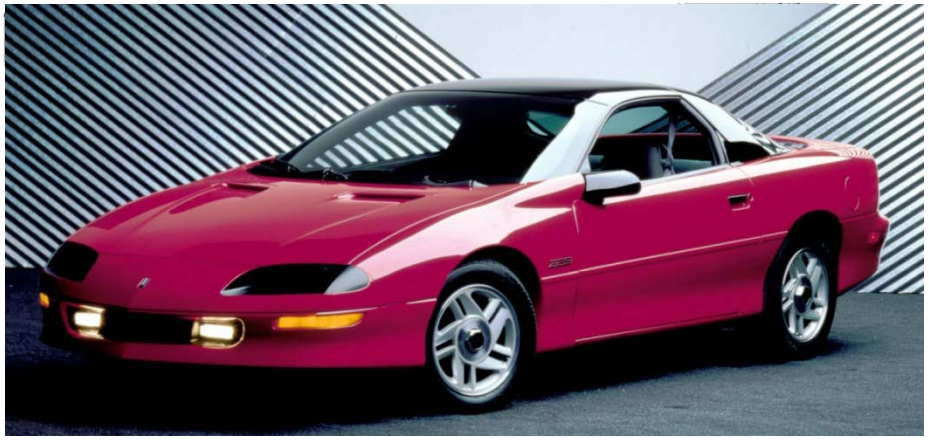
Straightway Speeds



- **Acceleration times**
  - Magazine test data usually include times for:
    - 0 - 30 mph
    - 0 - 40 mph
    - 0 - 50 mph
    - 0 - 60 mph
    - 0 - 70 mph
  - Calculation of distance covered is based on the area beneath the curve on a plot of velocity versus time

Camaro Specifications

TECH DATA



'93 Chevrolet Camaro Z28

GENERAL

Make and model	Chevrolet Camaro Z28
Manufacturer	Chevrolet Division, General Motors Corp., Detroit, Mich.
Location of final assembly plant	St. Therese, Quebec, Canada
Body style	2-door, 4-passenger
Drivetrain layout	Front engine, rear drive
Base price	$17,195 (est.)
	$19,812 (est.)
[illegible]ion	Dodge Daytona IROC R/T, Talon TS[illegible]

CHASSIS

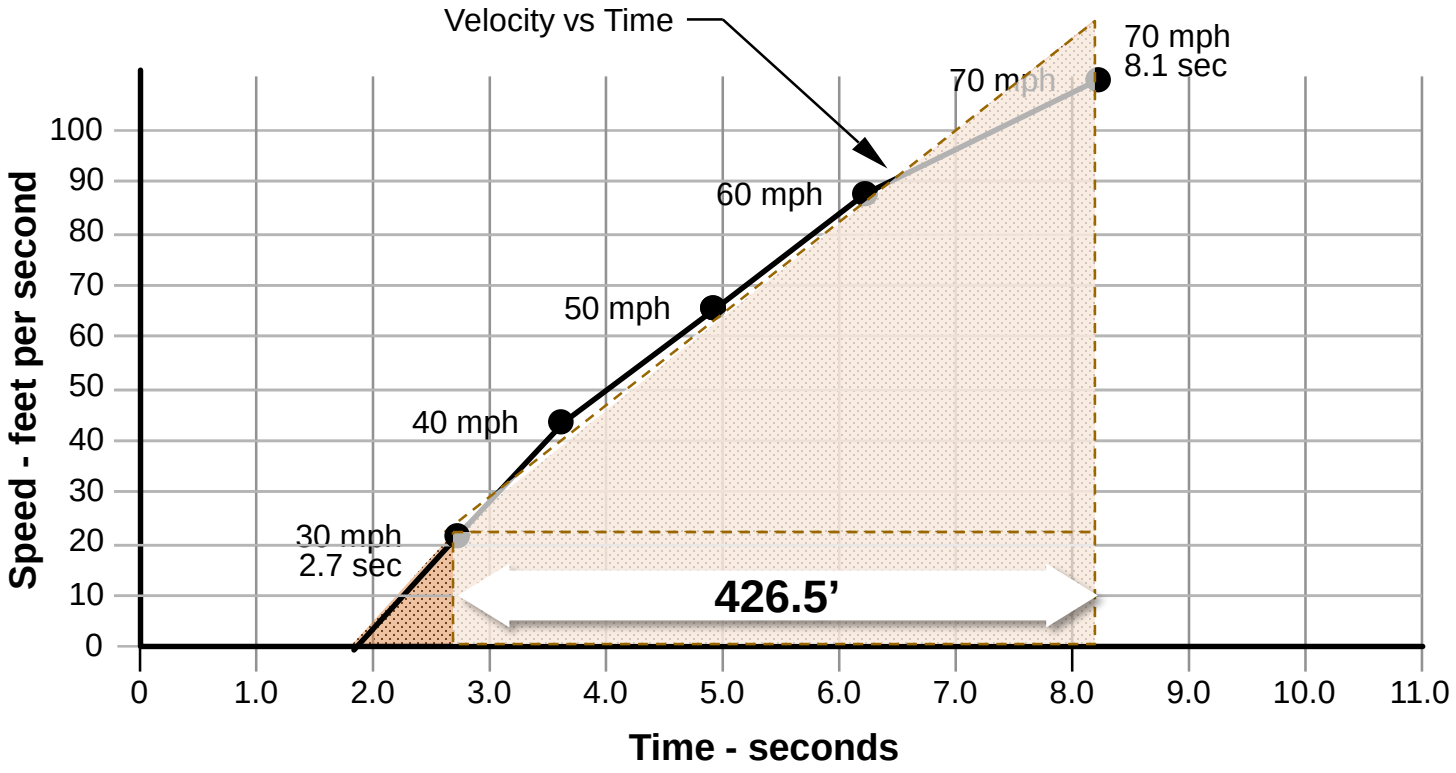
Suspension	
Front	Upper and lower control arms, coil springs, anti-roll bar
Rear	Solid axle, multilink with trailing arms and track bar, coil springs, anti-roll bar
Steering	
Type	Rack and pinion
Ratio	14.4:1
Turns, lock to lock	2.3
Turning circle	39.0
Brakes	
[illegible]nt, type/dia., in	Vented discs/10.9
type/dia., in	Vented discs/11.4
[illegible]k	[illegible]ndard
[illegible]nd tires	
[illegible]n.	
[illegible]nal	

PERFORMANCE AND TEST DATA

Acceleration, sec	
0-30 mph	2.7
0-40 mph	3.6
0-50 mph	4.9
0-60 mph	6.2
0-70 mph	8.2
0-80 mph	10.0
0-90	12.7
Standing quarter mile	
sec @ mph	14.7 @ 96.9
Braking, ft	
30-0 mph	31
60-0 mph	110
Handling	
Lateral acceleration, g	0.84
Speed through 600-ft slalom, mph	63.6
Speedometer error, mph	
Indicated / Actual	
30 / 30	
40 / 40	
50 / 50	
60 / 60	
Interior noise, dBA	
Idling in neutral	62
Steady 60 mph in top gear	75

Element Dimensions and Real Speed

Camaro
Velocity vs. Time



Camaro

Under full acceleration from 30 to 70mph, the Camaro will travel 426.25 feet in 5.5 seconds

Sentra Specifications

NISSAN
SENTRA SE-R

PRICE

List price, all POE $11,370
Price as tested ..... est $14,290
Price as tested includes std equip. (AM/FM stereo/cassette, elect. adj mirrors), air cond ($850), power sunroof ($800), [illegible] ($700), CD player (est $450), Calif. emissions [illegible] ($50).

IMPORTER

0–60 mph ..... 8.1 sec
0–¼ mi ..... 16.2 sec
Top speed ..... est 125 mph
Skidpad 0.82g
Slalom ..... 60.2 mph
Brake rating ..... very good

DRAWING BY BILL DOBSON

SCALE: 10 in. (254 mm) DIVISIONS
DRAWING BY BILL DOBSON

ENGINE

Type ..... aluminum head & block
[illegible] ..... dohc 4-valve/cyl
[illegible] ..... 122 cu in./1998 cc
[illegible] ..... 3.39 x 3.39 in./86.0 x 86.0 mm
[illegible] 9.5:1

DRIVETRAIN

Transmission	Ratio	Overall ratio	5-sp manual (Rpm) Mph
Gear			
1st	[illegible]	12.79:1	(7500) 38
2nd	1.83:1	7.63:1	(7500) 63
3rd	1.29:1	5.37:1	(7500) 90
4th	0.96:1	4.07:1	(7500) 119
[illegible]	0.76:1	3.16:1	est (6150) 125
[illegible]		4.18:1	
[illegible]		2950	

[illegible]ODATIONS
[illegible] 5
[illegible] ..... in.

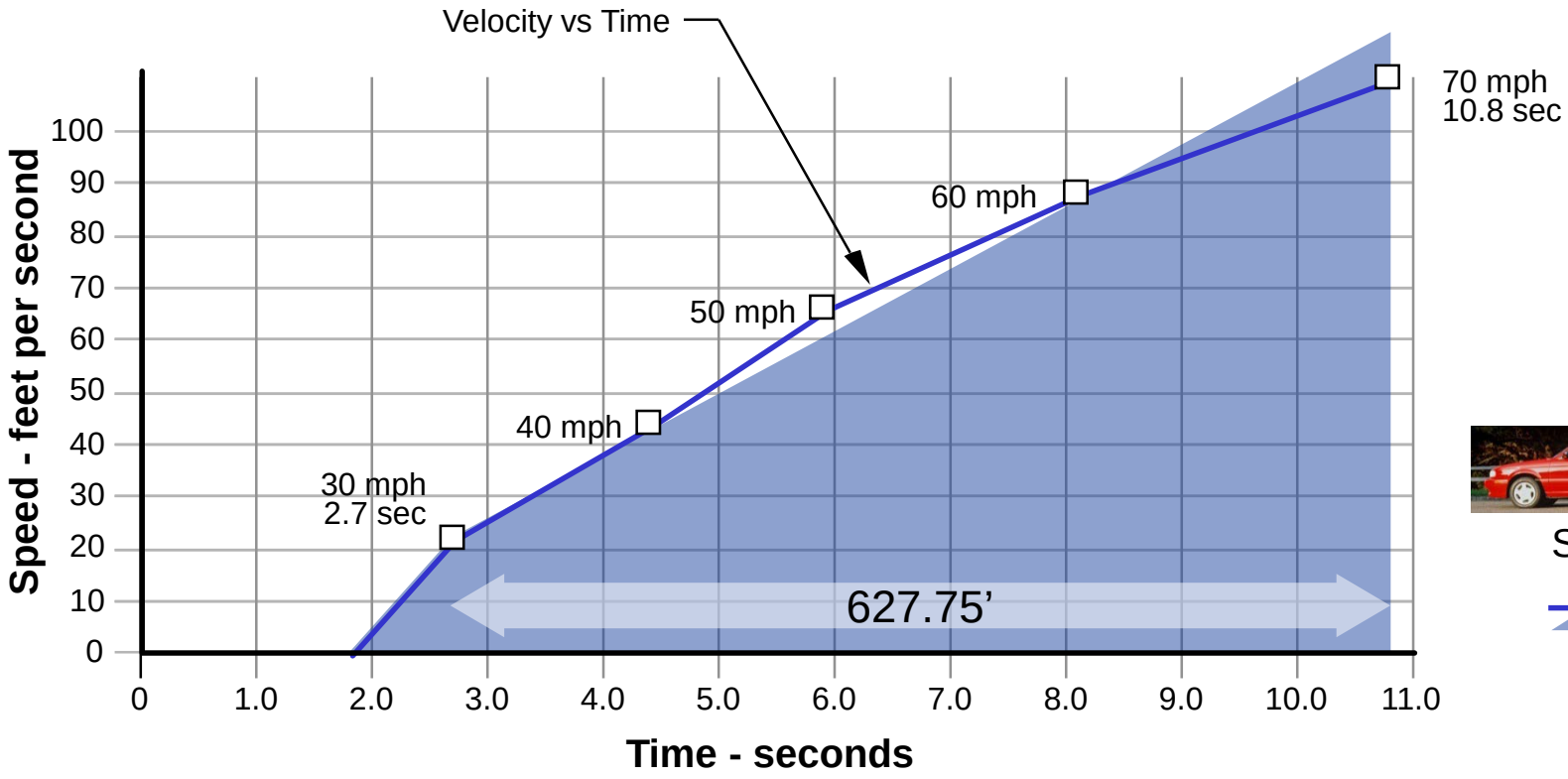
ACCELERATION

Time to speed	Seconds
0–30 mph	2.7
0–40 mph	3.4
0–50 mph	5.9
0–60 mph	8.1
0–70 mph	10.8
0–80 mph	13.6
0–90 mph	17.6
Time to distance	
0–100 ft	3.3
0–500 ft	8.7
0–1320 ft (¼ mi)	16.2 @ [illegible] mph

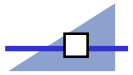
BRAKING

Element Dimensions and Real Speed

Sentra
Velocity vs. Time



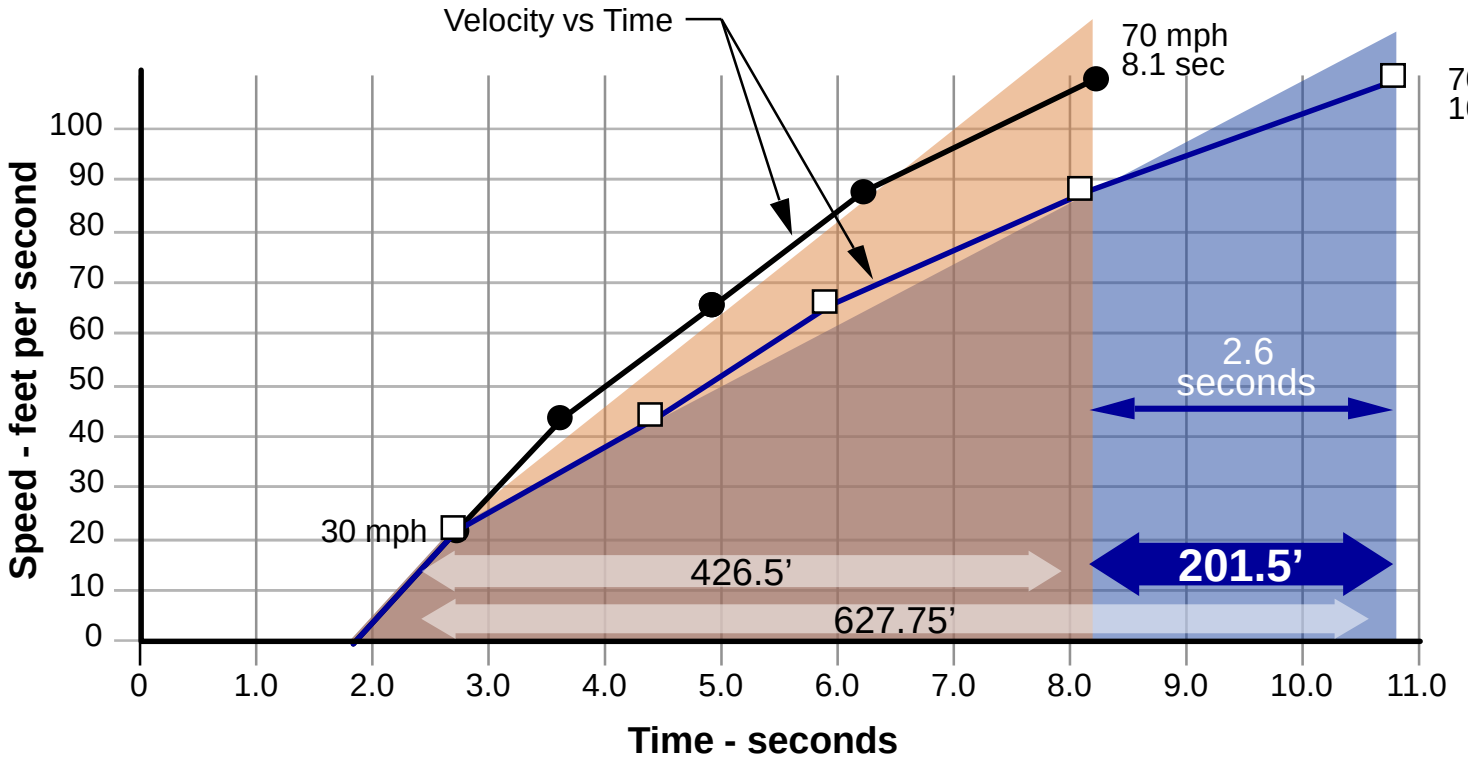
Sentra



Under full acceleration from 30 to 70mph, the Sentra will travel 627.75 feet in 8.1 seconds

Element Dimensions and Real Speed

Camaro and Sentra Velocity vs. Time



Camaro

Sentra

The Sentra would have to travel 2.6 seconds longer and 201.5 feet farther than the Camaro to reach 70 mph

How a Straight Gives Time to Power

- **How much effect can a big straight have on the competition?**
  - **Camaro:**
    - 30 - 70 in 5.5 seconds; 426 feet
  - **Sentra:**
    - 30 - 70 in 8.1seconds; 628 feet
      - Also reaches 351 feet in 5.5 seconds (Camaro = 426 feet in 5.5 seconds)
      - Finally reaches 426 feet in 6.35 seconds (which the Camaro did .85 seconds quicker)
- **O.K. - so what does that mean?**
  - The time advantage for the Camaro over a 426 foot straight section is about 0.85 seconds, or a total distance of 75 feet
- **How could the Sentra make up that difference?**
  - Either a secret nitrous container or go faster in the turns
    - To go faster in the turn, it needs a higher entry speed into the straight by 9.2 mph, so it would need to pull about 71% more G's in the sweeper
    - Hey folks - That's 1.43 G's - and that ain't gonna happen!

Why Do We Care?

- **How a straight gives time to a car with power**
  - The Camaro isn't classed with the Sentra, but classes do contain such mixtures
  - For example in **2016**, the **FStreet** class contains:
    - **1999 BMW 323i**
      - 3,200 pounds / 170 horsepower = 18.82 lbs/hp (where bigger = slower)
    - **2002 Camaro SS**
      - 3,600 pounds / 345 horsepower (oh my…) = 10.43 lbs/hp
    - That is a **44% difference in** power to weight ratio between cars in the same class
- **So what does that have to do with a Camaro/Sentra comparison?**
  - **Sentra**
    - 2,600 pounds / 140 horsepower = 18.60 lbs/hp
  - **1993 Camaro V8**
    - 3373 pounds / 275 horsepower = 12.30 lbs/hp
  - That is only a **34% difference** between the cars in our example

Horsepower to weight disparities within class structure make it essential to balance your course design between power and handling

Speed in Solo2 Course Design

- **How fast do we go?**
- **Why do we care?**

The following is critical to allow us to continue our sport…

What the Rules Say

- **"…should not normally exceed the mid-60s (mph) for the fastest Street and Street Touring® category cars"**
  - This doesn't mean the average: it means the maximum
  - Don't try to get cute with "normally"

Why Is Speed Compliance So Important?

- **Keywords (from Risk Management):**
  - Negligence
  - Gross Negligence
  - Release/Waiver Effectiveness
  - Punitive Damages
  - Compensatory Damages
  - Insurance Rates
  - Coverage Refusal

What's The Point?

- A good **Street or Street Touring® car** can get a **lot more speed** a lot more quickly than many people realize (remember, the rule says "**fastest**")
- It's easy to figure these things out in terms of something simple like the **length of a straightaway**, or the **size (radius) of a turn**
- This is different from the "**I could have sworn they'd have to lift there**" problem

What Does All This Mean?

- A **Stock Z06** can get from **30 mph** (speed in a sweeper of ~65’ Radius) to **80 mph** in just over **400 feet**
- There are probably **SP cars** that can do it even **quicker**
- Pure straights much **over 400 feet** in length are iffy; much longer ones are just plain irresponsible

What Can You Do?

- **Have higher density of quick elements that are not straights; which can be plenty of fun**
  - Connected sweepers (“esses”)
  - Lane changes
  - Big slaloms (70’-80’ spacing)
  - Elements that require throttle modulation and/or even *(horrors)* a little braking

What Should You Not Do?

- **As administrators:**
  - Don't let course designers think they have the last word (Event Chairs and Safety Stewards do)
  - Don't rationalize "letting it go this time"
  - Don't listen to competitors who whine about not being able to go "real fast"

What Should You Not Do?

- **As designers:**
  - Don't focus on "pushing the envelope" with regard to speed
    - Focus instead on delivering a challenging, fun driving experience that provides quality competition
  - Don't put a tightening transient element near the end of a fast stretch, to slow cars down (recipe for sedan rollovers)

Protect Our Sport

- **If Solo, as the Rules define it, isn't what someone wants to be driving, they should go try something else**

- **These folks should not be allowed to corrupt our sport into something it was never meant to be: they put us all at risk!**

Agenda

- Fundamentals
- 10 Basic Concepts
- So you have a Blank Piece of Paper...
- Elements, Dimensions and Real Speed
- Summary and Questions

Questions? Comments? Good Stories?

Stolen from http://www.flickr.com/photos/brettkiger/5699668143/

Contact Information

- **Remember, the more courses you design and set up, the better your courses will be**
- **Please feel free to contact me with any future questions**
  - I can be reached as listed below:
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- **Complete Course Design Booklet**
  - http://houscca.com/solo/courses.php
    - Then scroll to the bottom of the page and select **Solo Course Design Manual**