

Solo Course Design Challenges

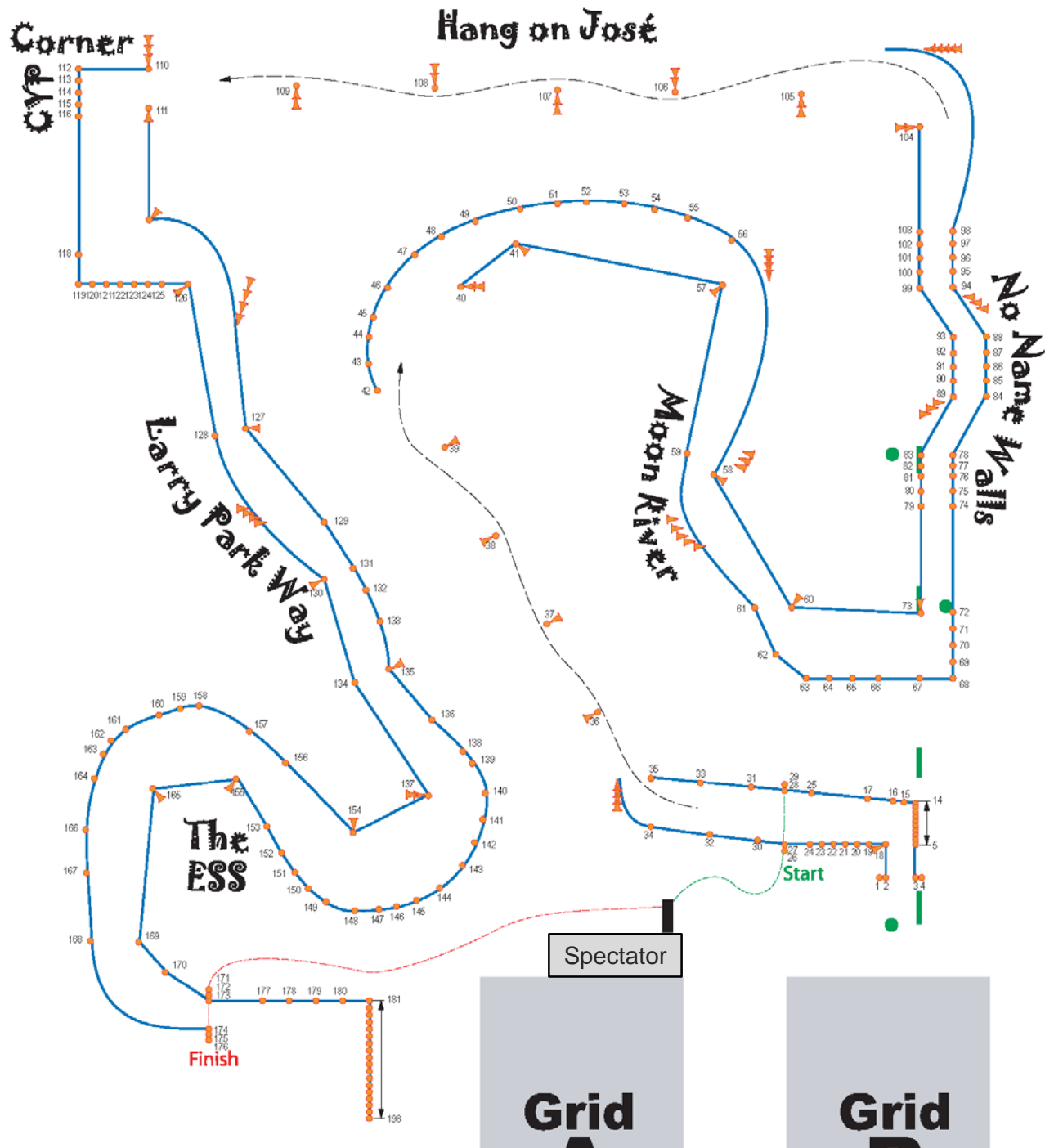


2016

presented by

Roger Johnson


(Roger the Real)



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”
 - Benefits of a scale map
 - Analyze speed and safety of your design, maximum use of course area, and accurately show corner workers their area of responsibility
- **Then place start and finish lines**
 - Establish clear access to the start and from the finish
- **Timing and scoring location**
 - Ensure timing crew can easily read car numbers and view the entire course
- **Consider placement of the course workers**
 - Workstation located where all cones can be replaced without start delay/red flag
- **Check out the conditions of the surface**
- **Allow for multiple cars (site and timing software allowing)**


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

Do Not



- ...**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

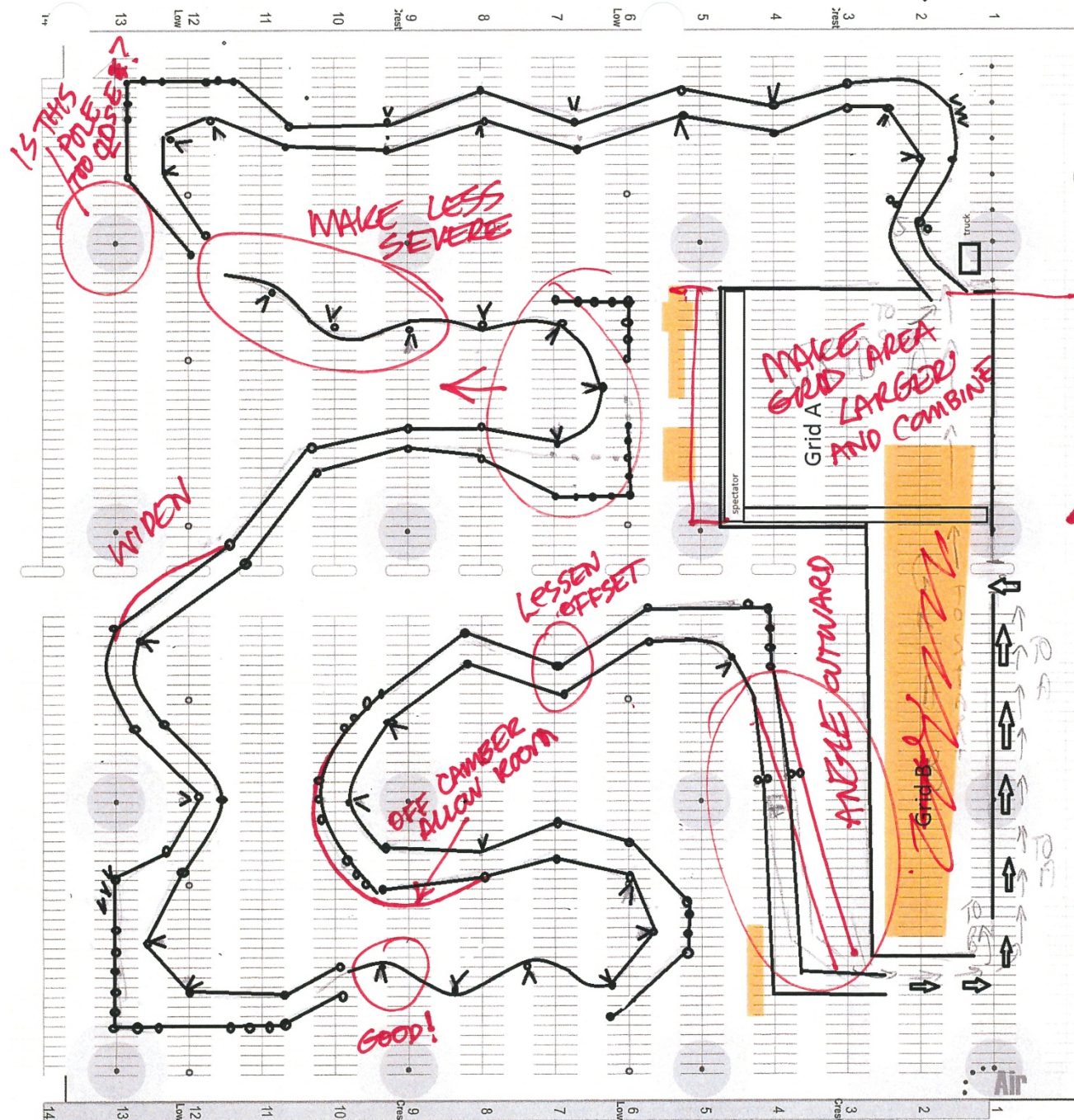
- **As a course designer, you will become an artist; according to Webster, an artist is “one who professes and practices an imaginative art”**
 - Believe me, imagination is required to create a course that is interesting and fun to drive - and when the course design is completed, you will feel like you 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)

Freedom to
USE 9' wide
ALL
11 spaces
REMEMBERING
9/11 on
September 11, 2011

Bad Asphalt Sec
Do Not

Car # _____

Class _____

Run Heat _____

Work Heat _____

Set yourself Up for Success

(continued)

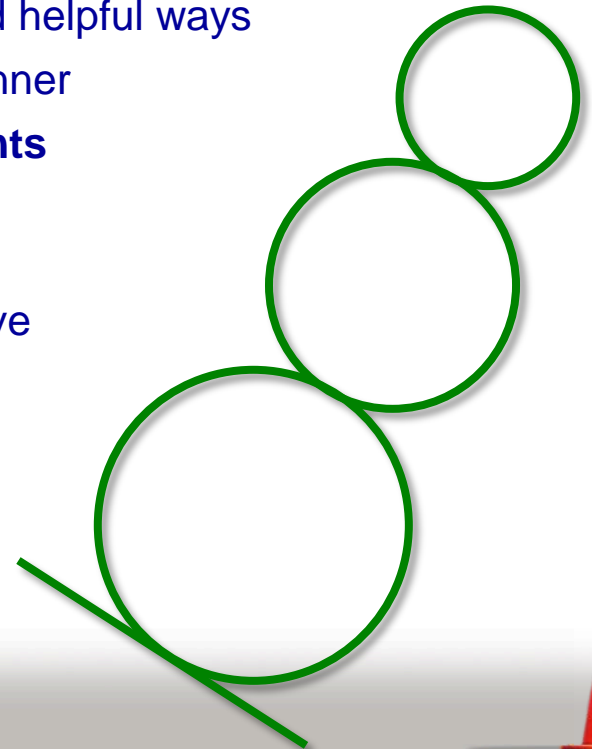
- **After the peer review**
 - **look over and analyze** their comments
 - Address all **safety** related comments
 - **implement** any you feel improve the design
 - **Be true to your basic concept**
 - Put **your own style** into their suggestion; that is why you got the ‘hows and whys’
- **The great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

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

Fair, Fun and Safe Competition

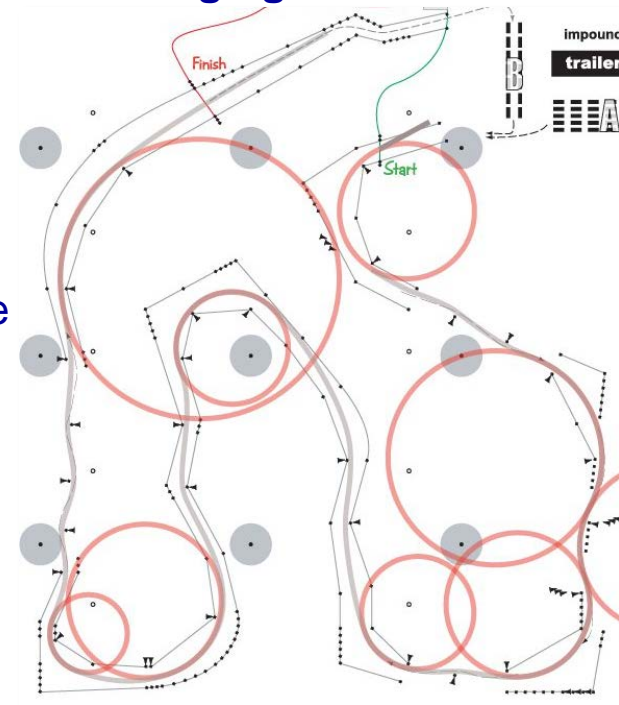
2.) Use Creativity

- 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

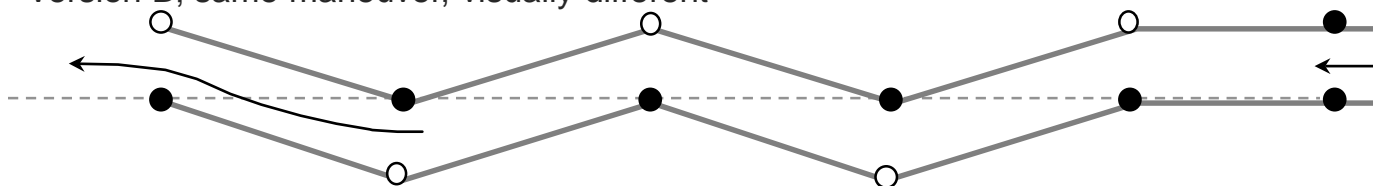


5 Cone Slalom

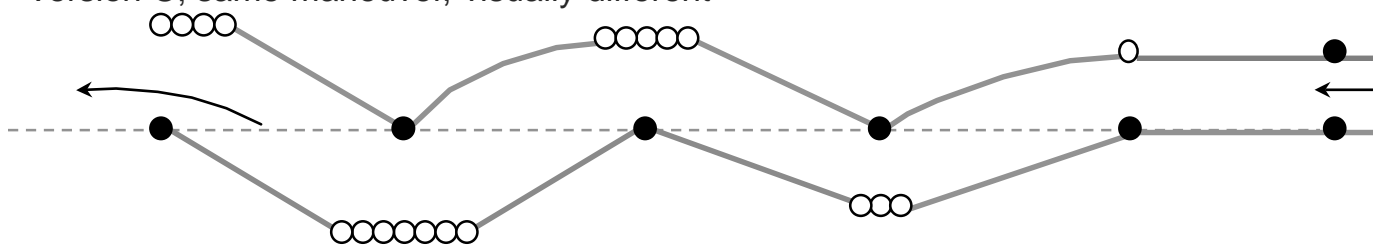
Version A; Basic 240 foot 5 cone slalom



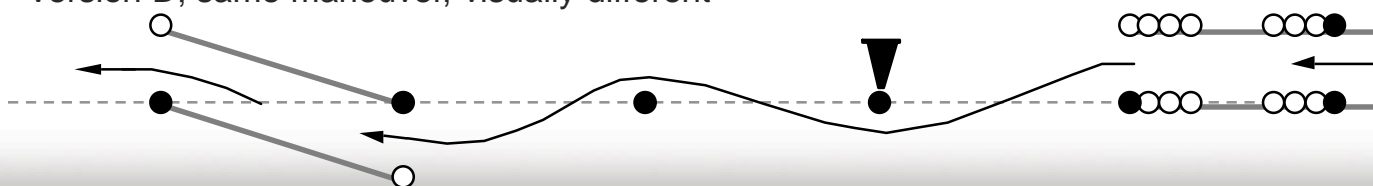
Version B; same maneuver, visually different



Version C; same maneuver, visually different

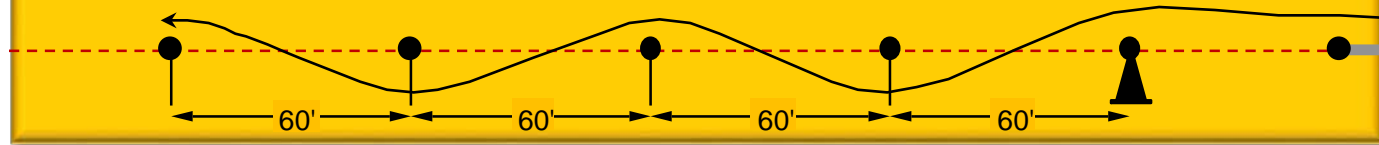


Version D; same maneuver, visually different

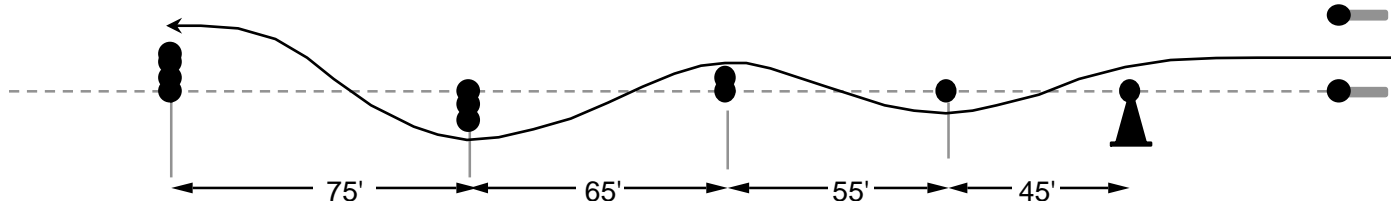


5 Cone Slalom (continued)

Version A; Basic 240 foot 5 cone slalom

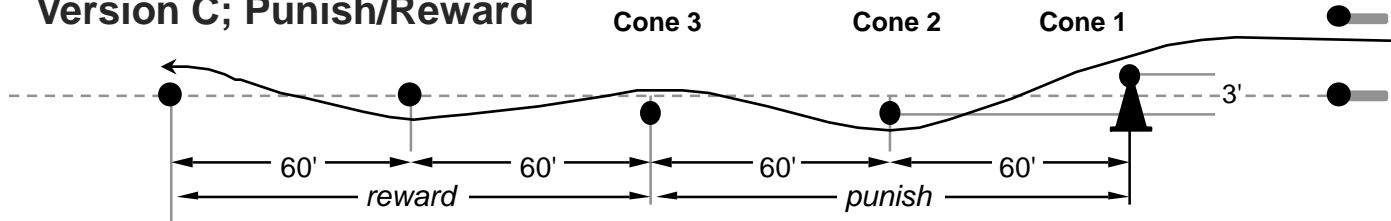


Version B; Change for interest



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

Version C; Punish/Reward



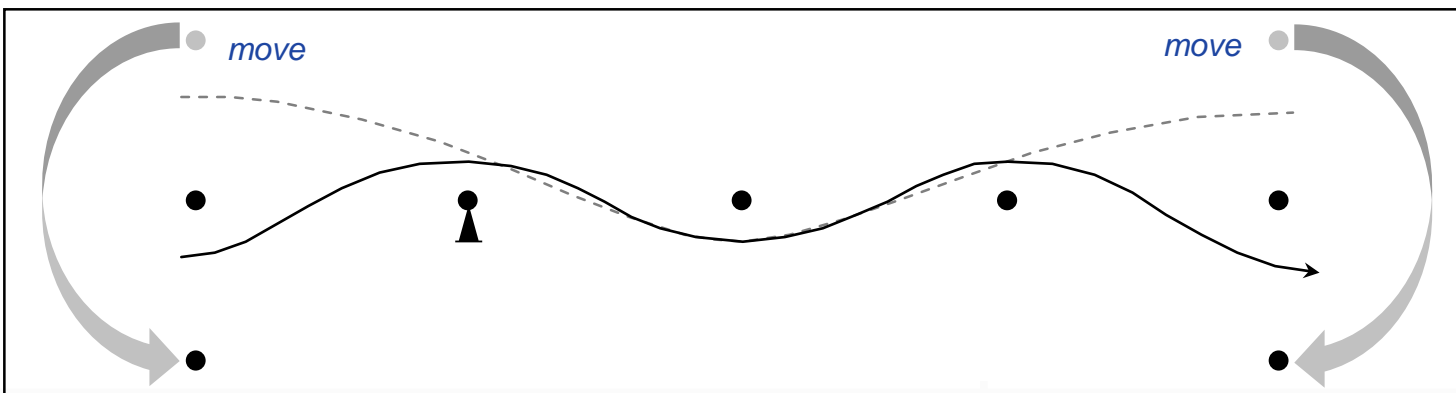
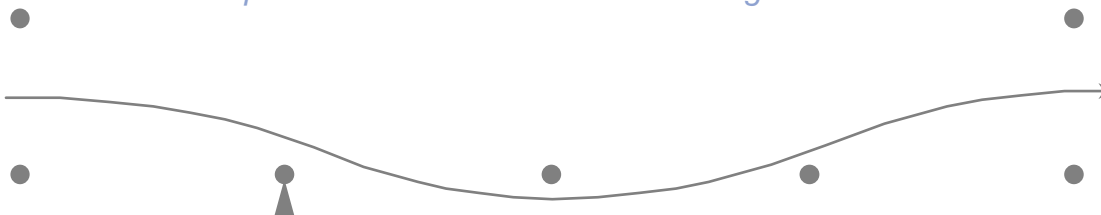
Note: Cones 1 & 2 are offset 3' the hard way with cone 3 offset 1.5' the easy way. This opens up a "Lotus freeway" through the last 3 cones of the slalom. To make the punishment bearable, be sure to allow adequate set up area prior to the punishment, otherwise the punishment becomes painful

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

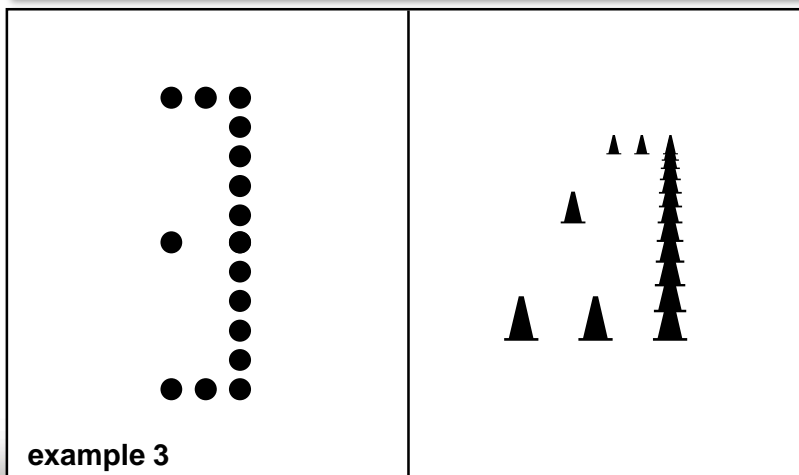
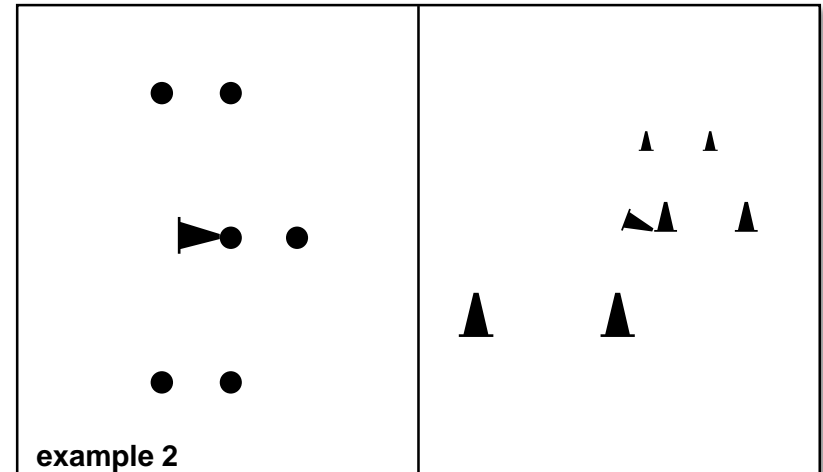
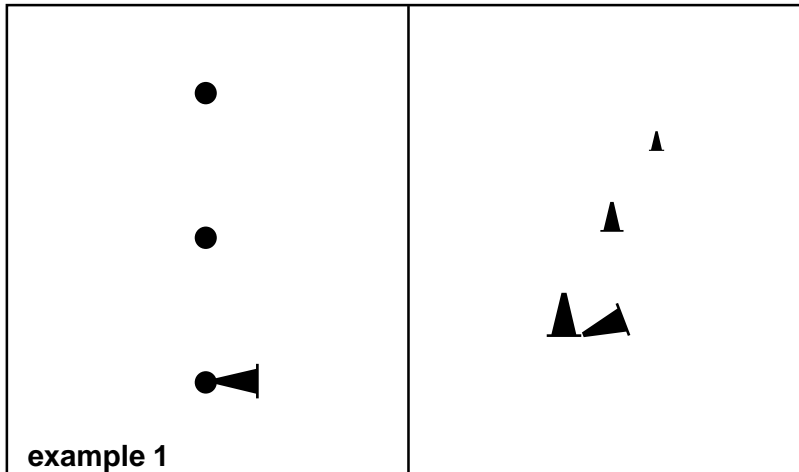
3 Cone Slalom

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

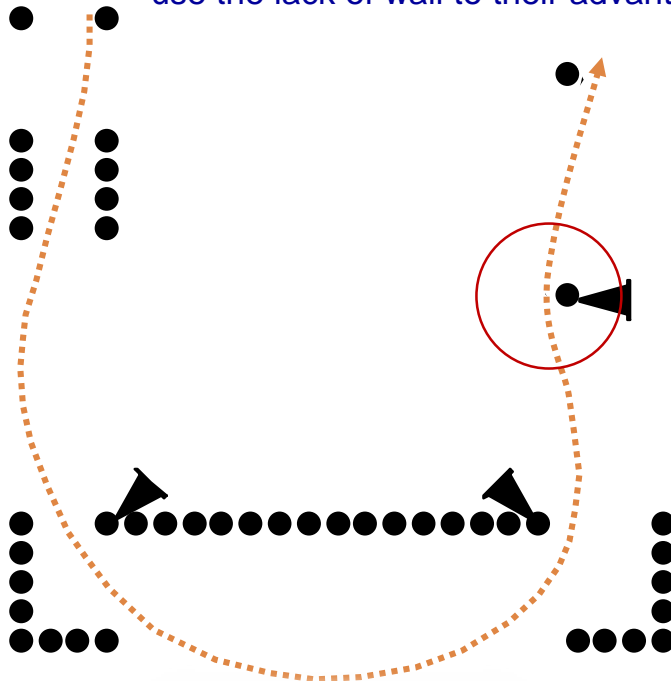
For instance, if you have several walls of cones following this slalom, example 1 would be most appropriate; and if not, examples 2 or 3 might be more appropriate

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

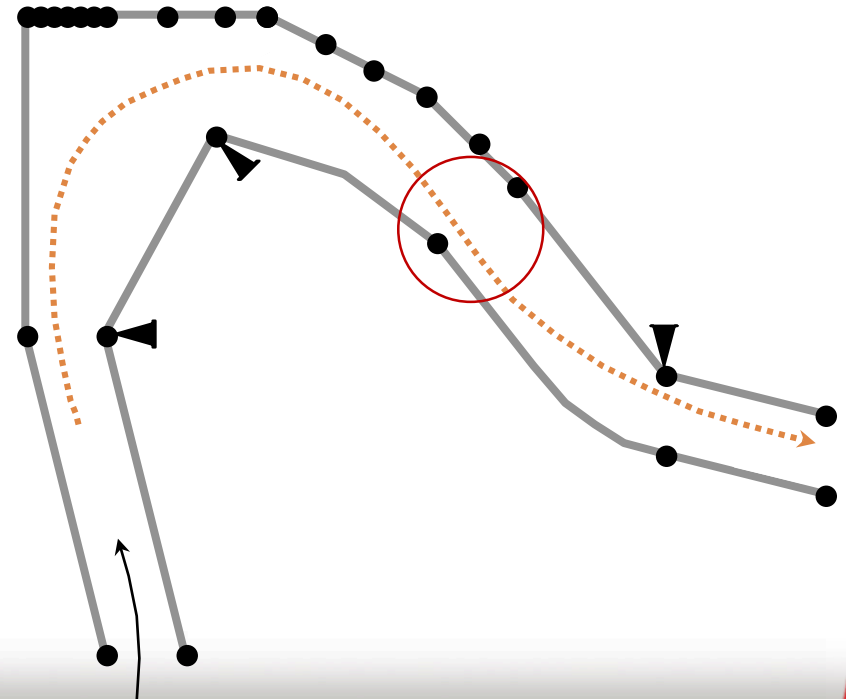
The wall at the 180° will tend to make an unwary competitor square the corner out. The driver who looks carefully will round the corner out and use the lack of wall to their advantage



note lack of wall here

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"

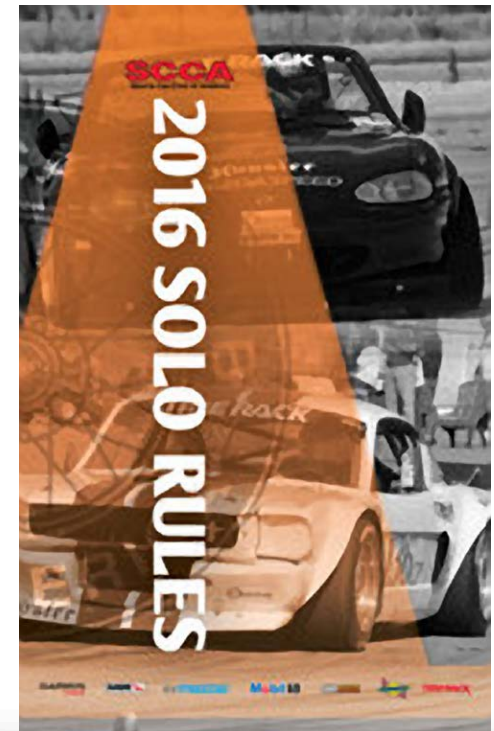


With a hidden agenda the result is a course that only a few people enjoy - or perhaps even a course that **NO ONE** will enjoy!

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

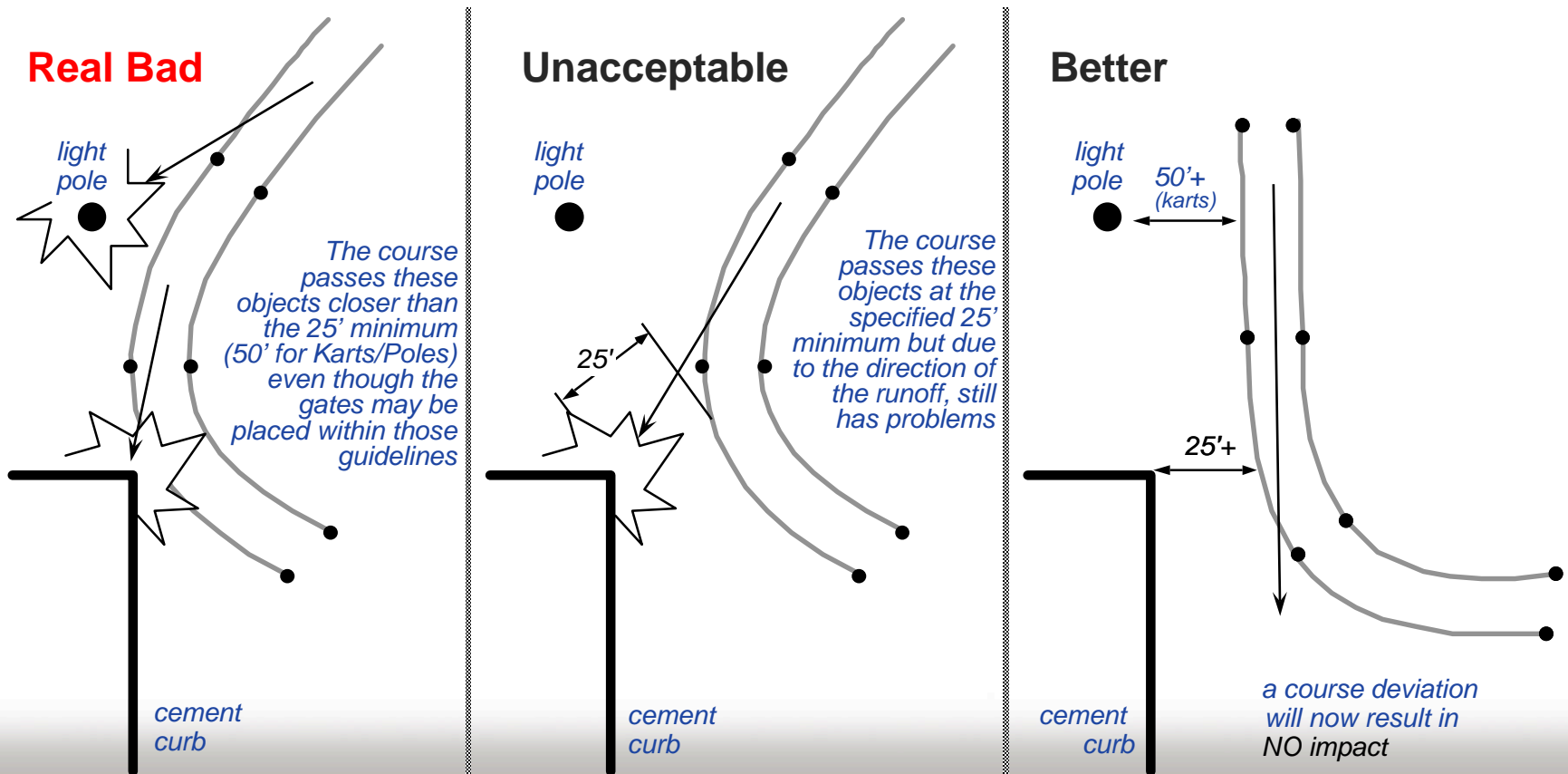
- By knowing the rules in Section 2.0, you will be able to create a design that will be a Solo type course, as well as a design that is acceptable to the Solo Safety Stewards and your peers
- The following are diagrams taken from some of the 2016 rules
 - ALL of the rules, of course, are important and 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



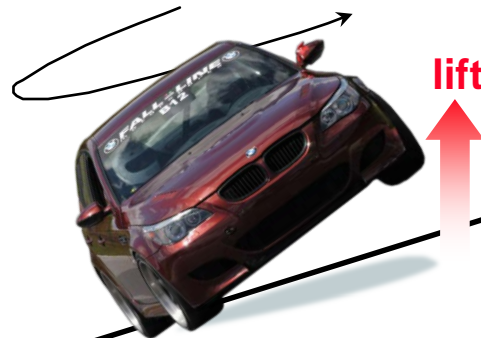
2.0 Diagrams (continued)

2.2.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...)

Negative Camber Left Turn
Direction of car



A Car tends to roll left on a right turn and right on a left turn. So, use the hill to counteract this phenomenon on a sharp turn

Positive (on) Camber Left Turn
Direction of car



Sewage Grate
Area

Sewage Grate
Area

Crest of Hill

Valley of Hill

Light Pole

Sewer Grate

Finish

Start

B

A

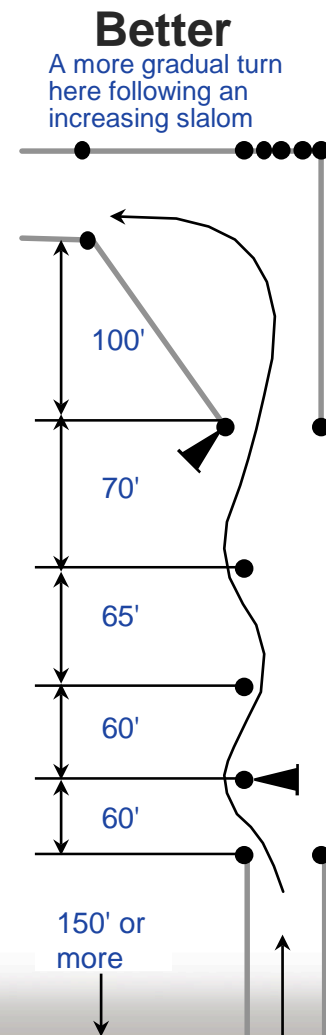
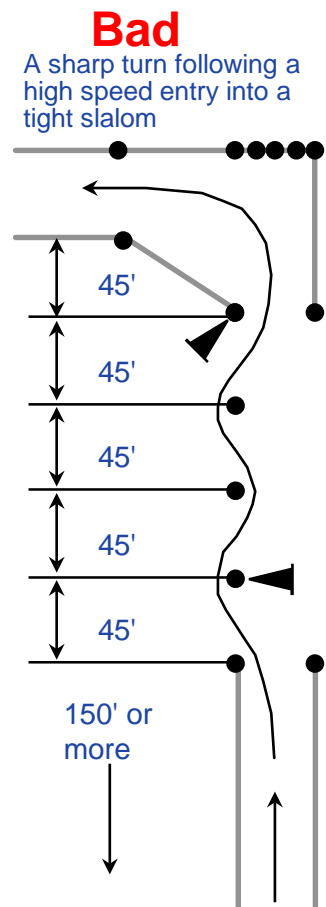
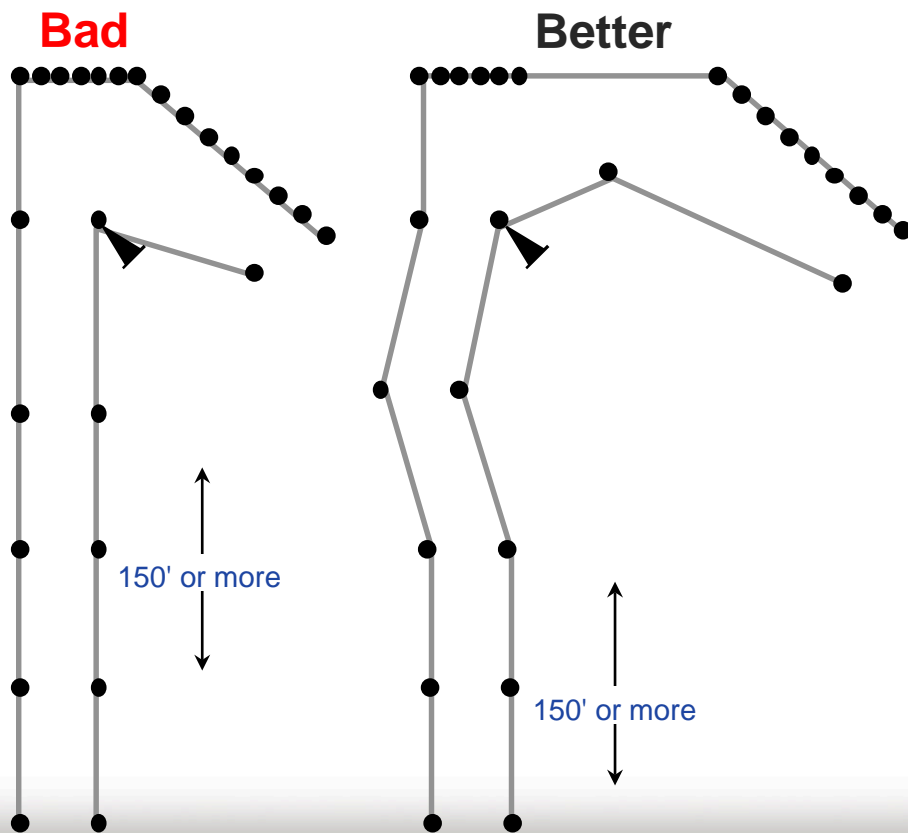
C

E

D

2.0 Diagrams (continued)

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

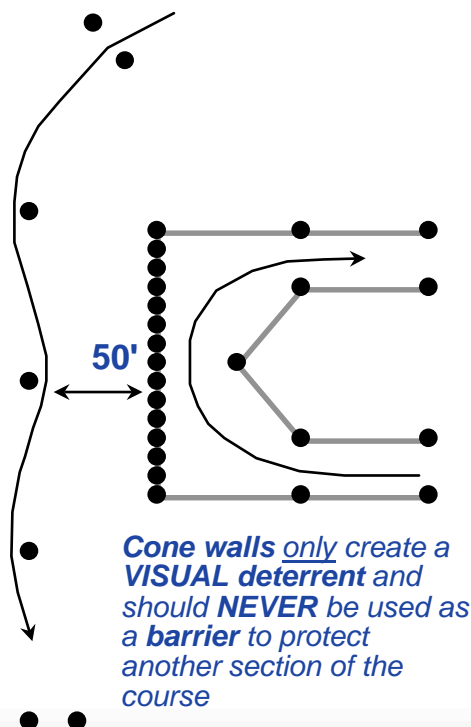


2.0 Diagrams (continued)

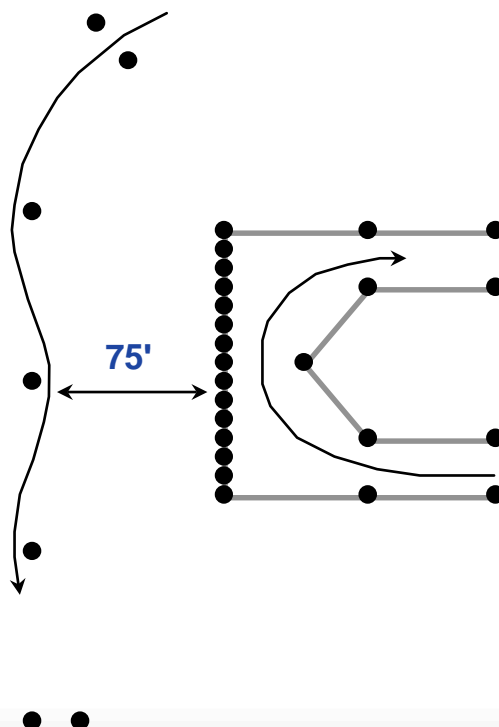
2.2.H Cars on course simultaneously shall not run in close proximity to each other

"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.

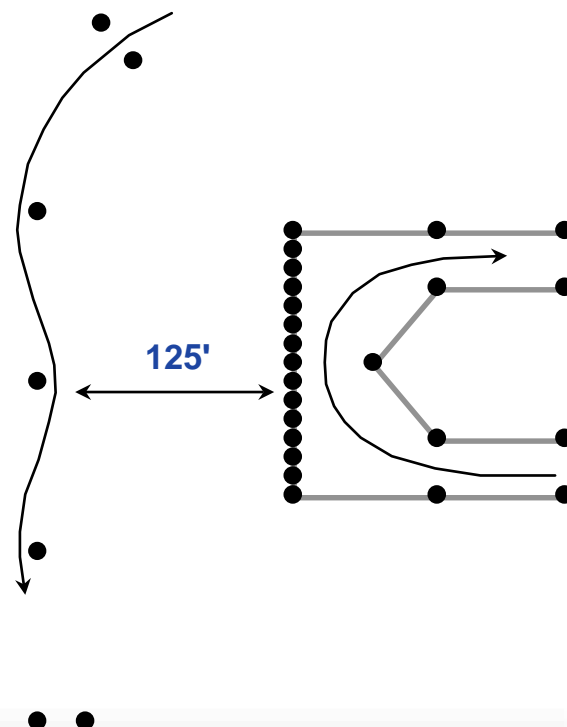
Unacceptable



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

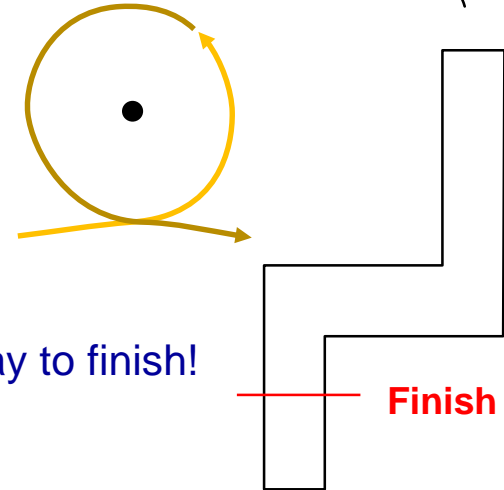
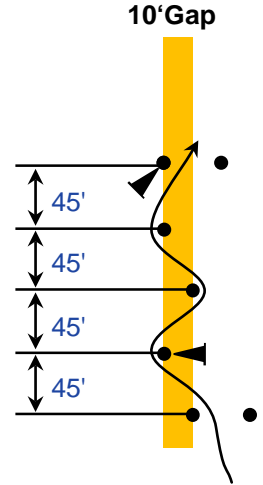
Your course should have the same characteristics - If a car cannot be maneuvered through the obstacles smoothly, the course does not flow

Ways to Make Your Course Flow

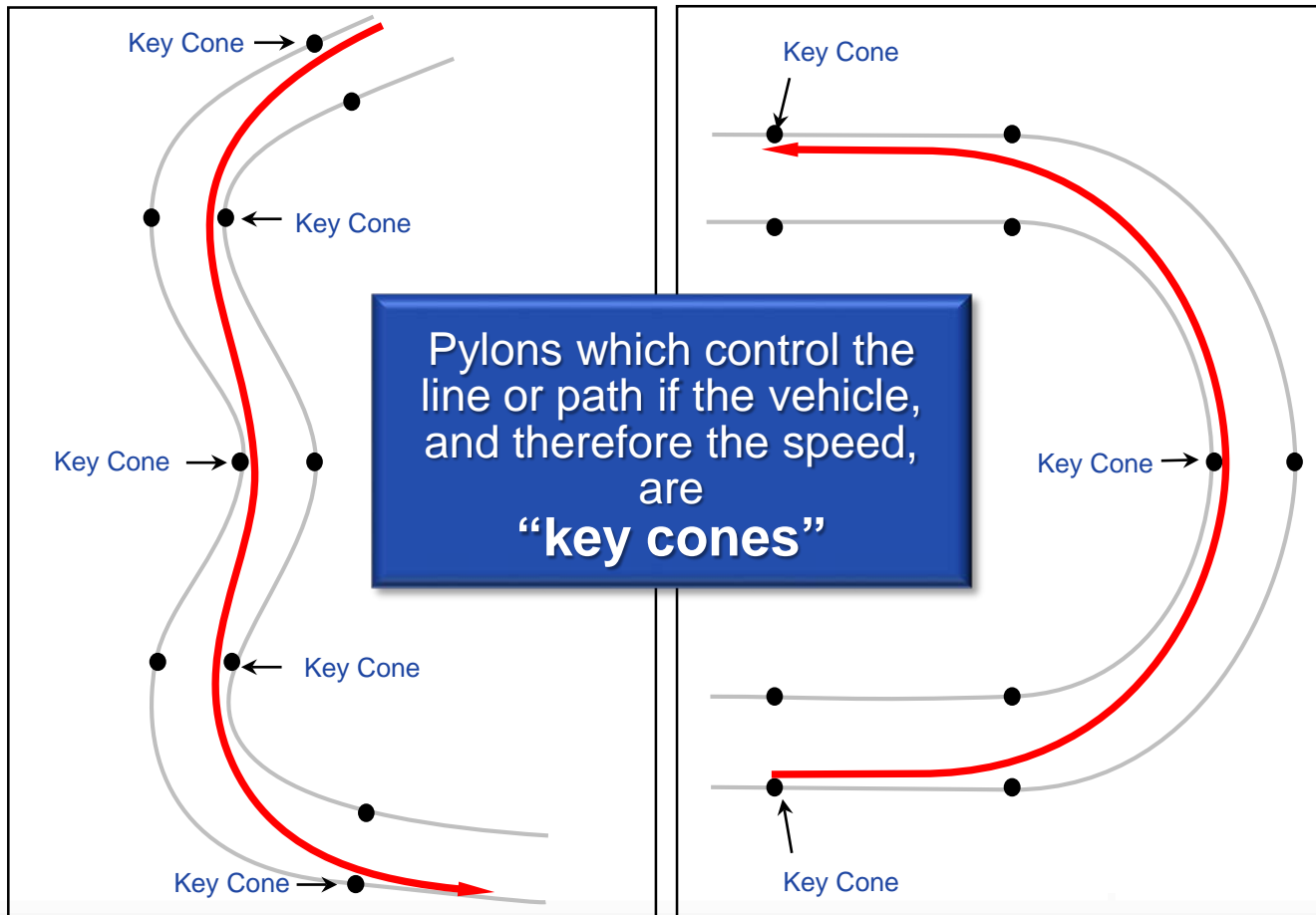
- To be able to accurately determine the flow of a course before you set it up, you must be able to first draw a **scale map** (gasp!)
 - **Visit the site before** submittal of your map to make your map accurate and to include things and land formations to avoid
- **Locate the “key cones” in your design**
 - 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

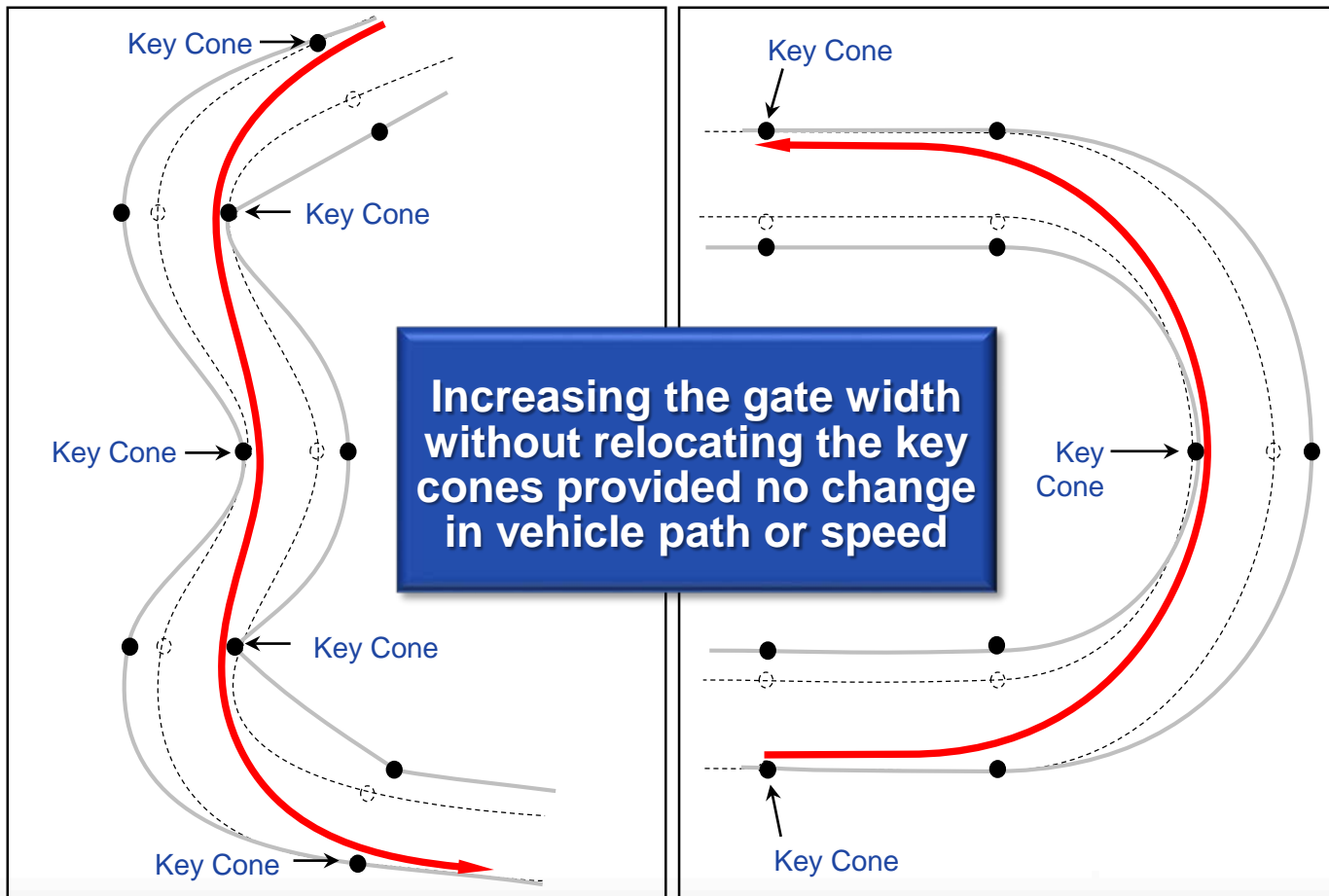
- **Avoid maneuvers that could make a car roll**
 - Don't use significantly **off camber turns**, especially right turns
 - Don't use **decreasing radius right turns** - especially sharp ones
 - Avoid **"one-two"** hard corrections following a fast section as can be found in a decreasing slalom
- **There are also a few "No Fun Maneuvers" (NFM) 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

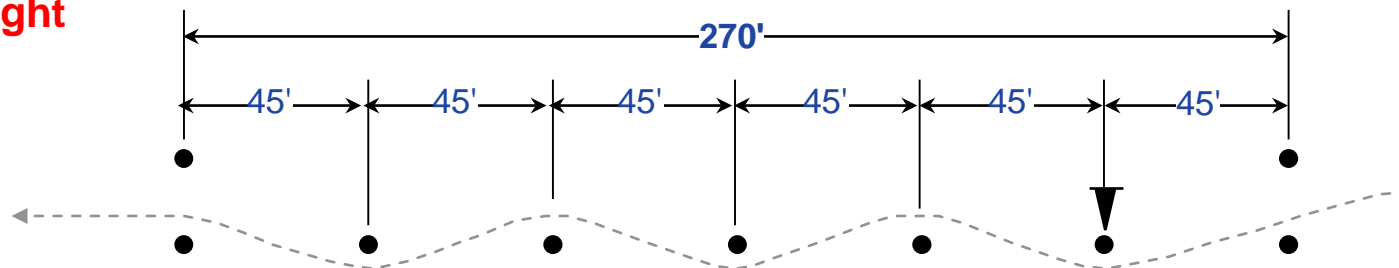


Advantages of wider gates

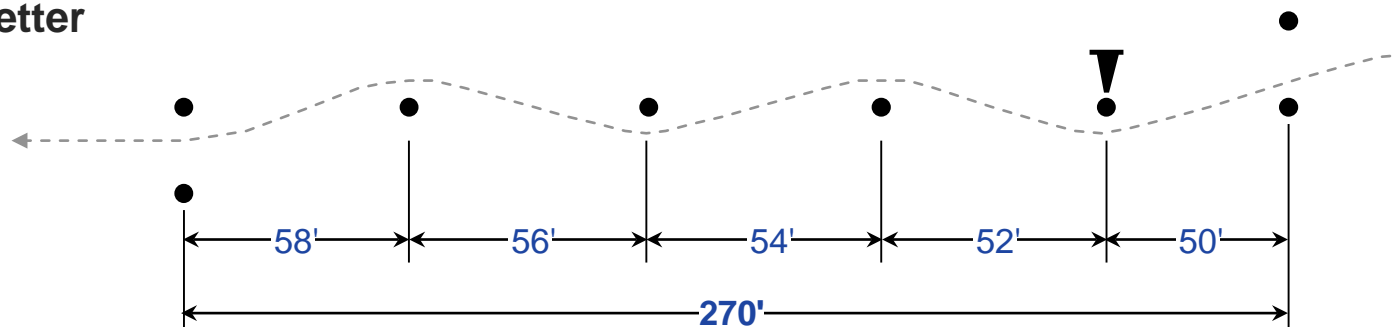
- Choosing the **superior line** requires more skill and experience
- **Allows** for mistakes/sloppiness with **no pylon** penalties
- **Easier** on course **workers** and timing & scoring

Remove a Slalom Cone

Tight



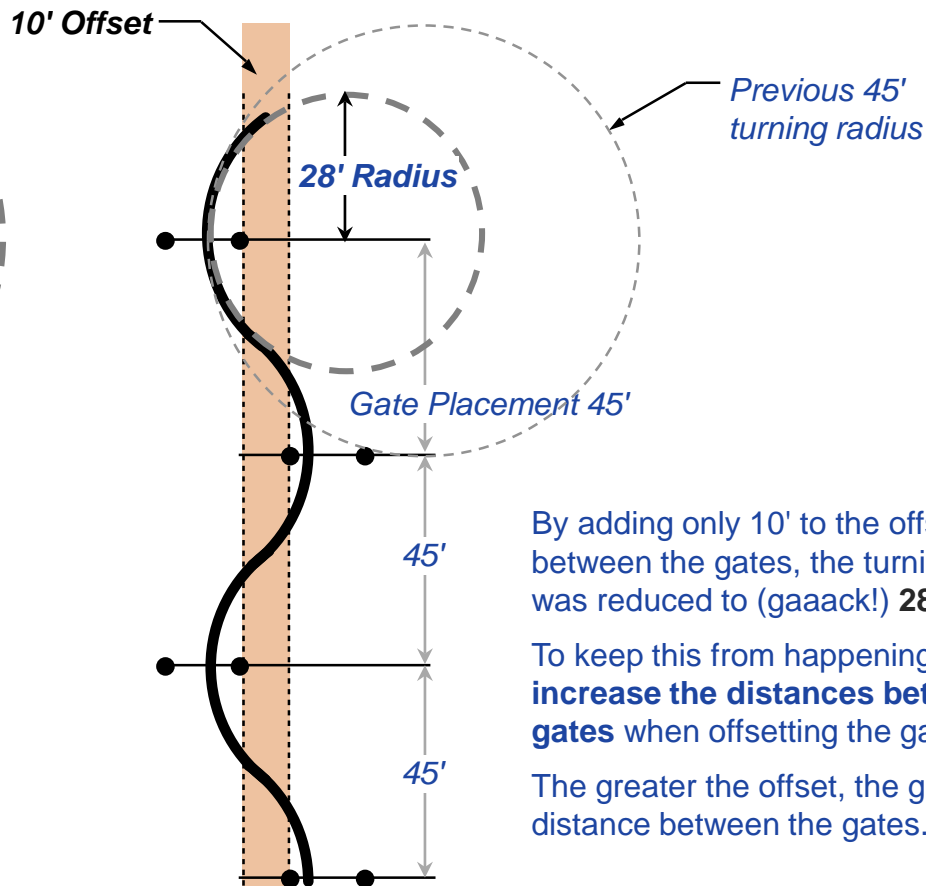
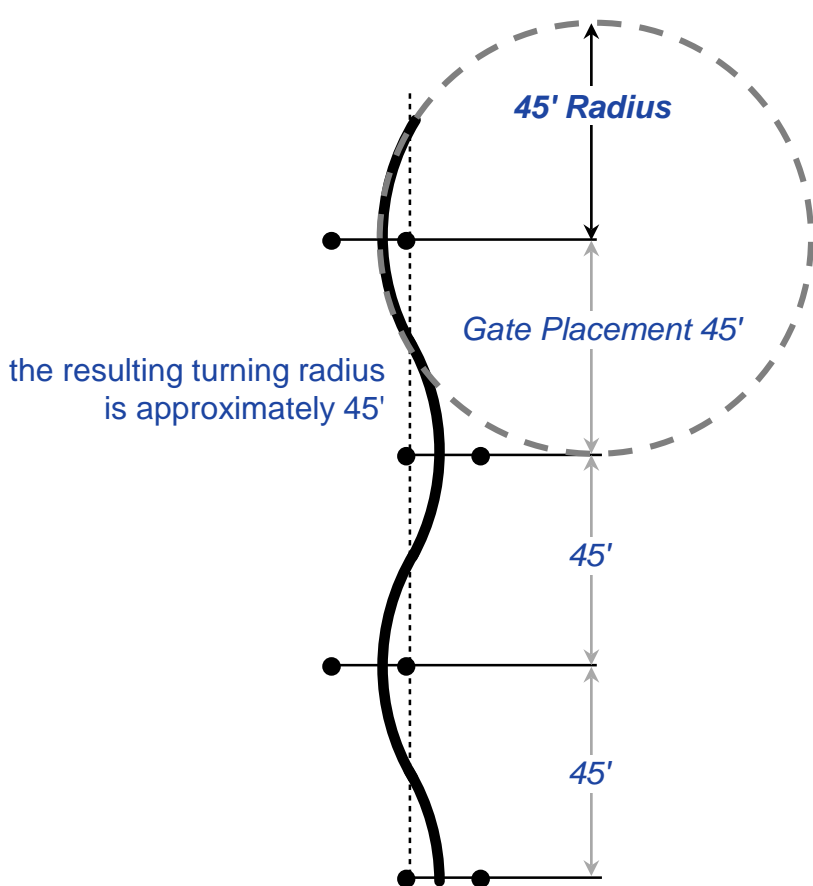
Better



- 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



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

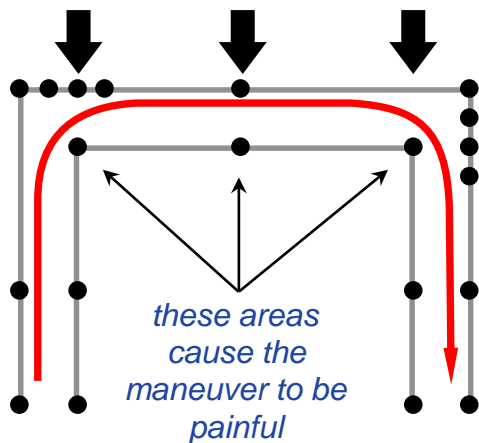
To keep this from happening, **increase the distances between the gates** when offsetting the gates.

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

Avoid “Painful” Walled in Turns

Painful

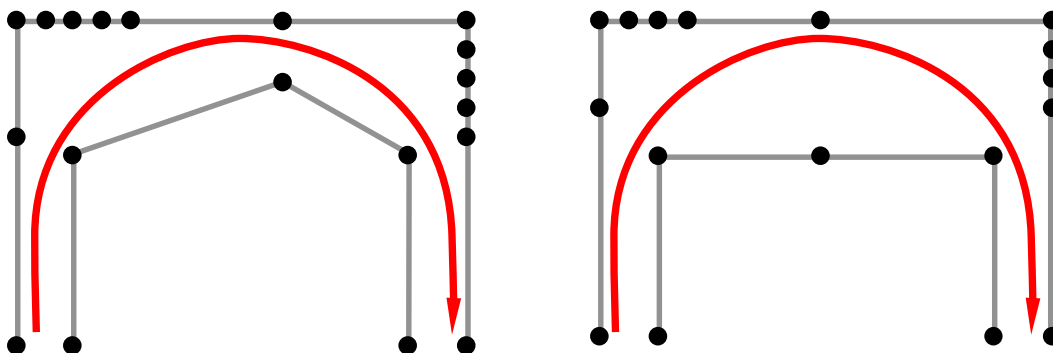
Narrow, walled in sharp turns



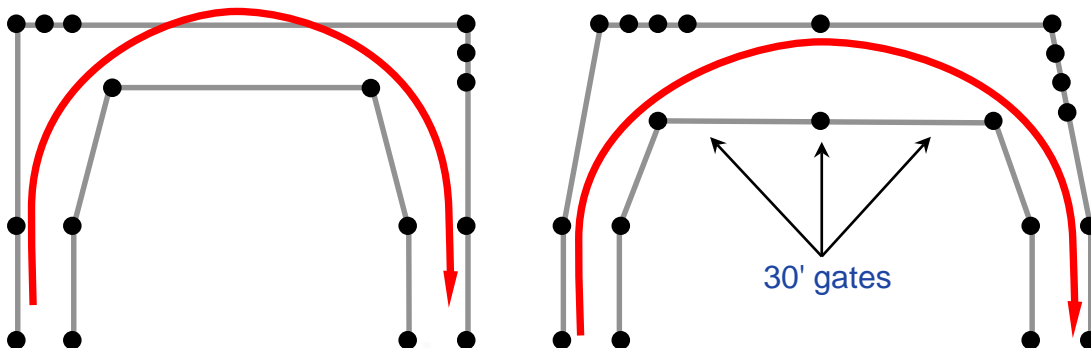
The placement of the wall
forces the turn to be made up
of **2 or more painful turns**
instead of a flowing turn

Better

solutions keeping the same flavor as the original



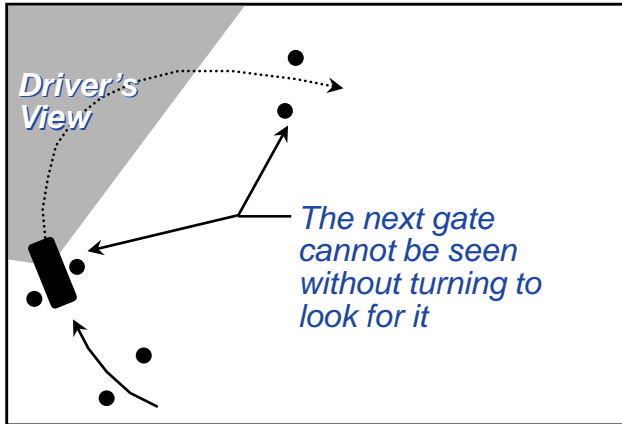
1 flowing turn...



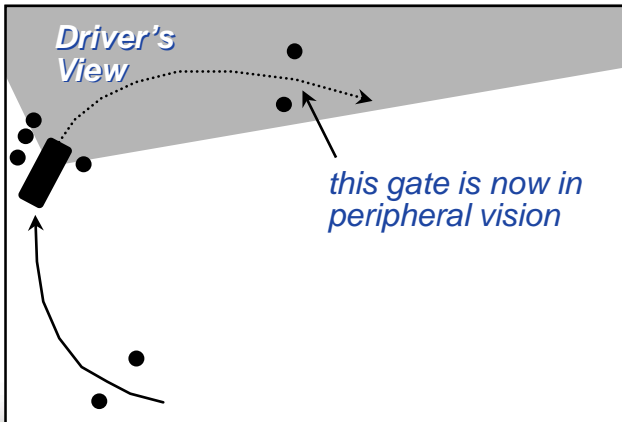
18' gates

Line of Sight and Gate Positioning

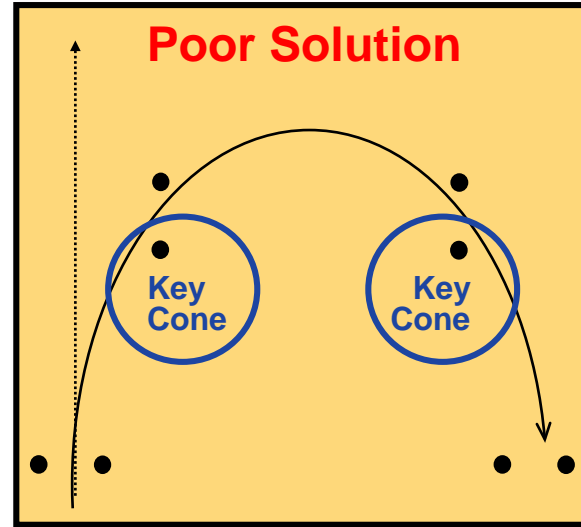
Bad



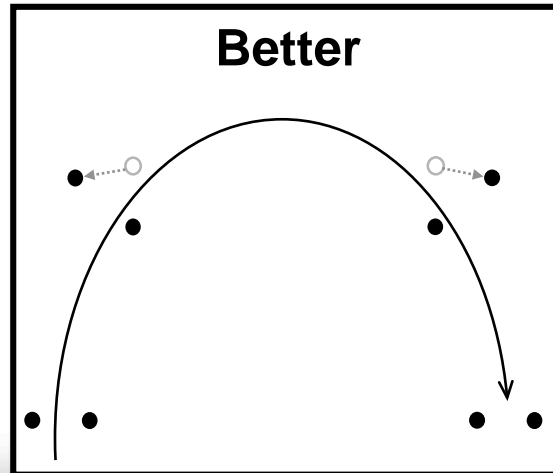
Better



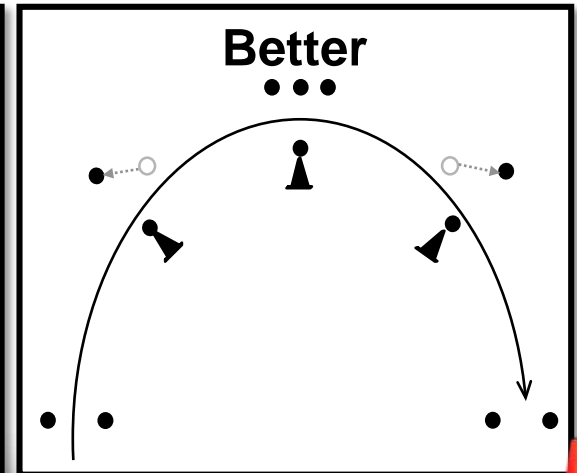
Poor Solution



Better



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

straights (duh...)
long spaced slaloms and large radius sweeping turns
sharp turns (90 degree or more)
maneuvers connected with straights
open maneuvers
etc.

handling

short to medium spaced slaloms
small radius sweeping turns
chicane/lane changes
successive maneuvers
tight maneuvers
etc.

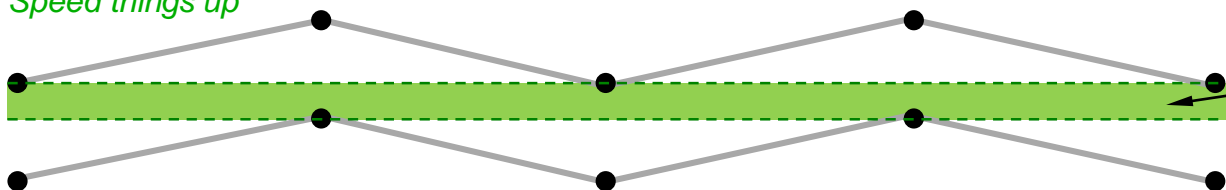
- **A straight is any area where full acceleration can be utilized, and is not just the classic definition of the shortest distance between two points**
 - A slalom spaced greater than 100' can be considered a straight

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”

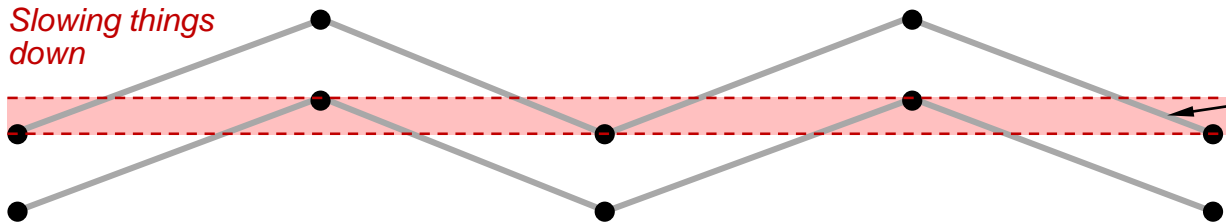
Speed things up



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



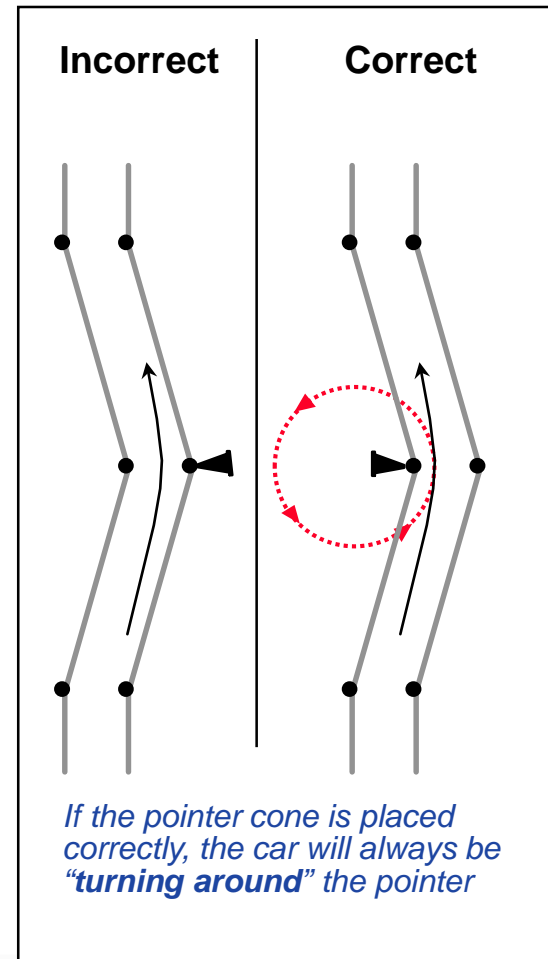
By increasing this **overlap**, you will effectively **decrease the speed** of the maneuver. A small increase here will also have a surprisingly large effect

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

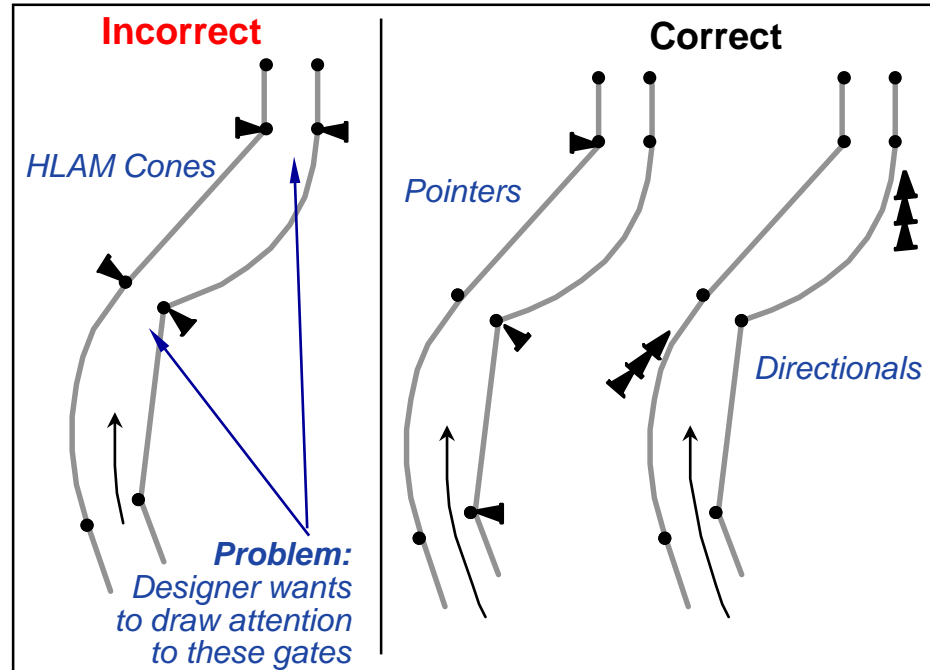
- **Pointers**

- 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



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

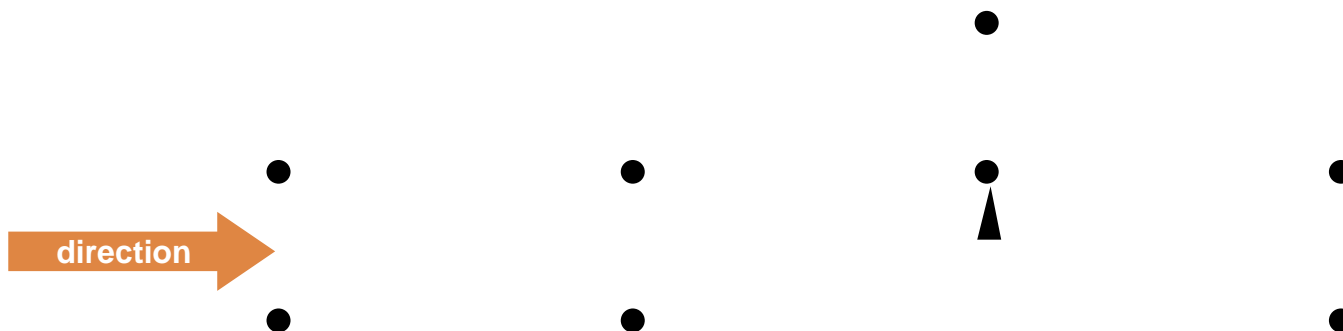
- Do not place cones or gates at intervals **similar to the width** of gates being used
 - For example, do not place gates going around a sweeping turn **25' or 15'** apart if all of your gates are **20'** wide
 - This creates a visual nightmare called “**Cone Hell**” since, at speed, all openings appear 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.

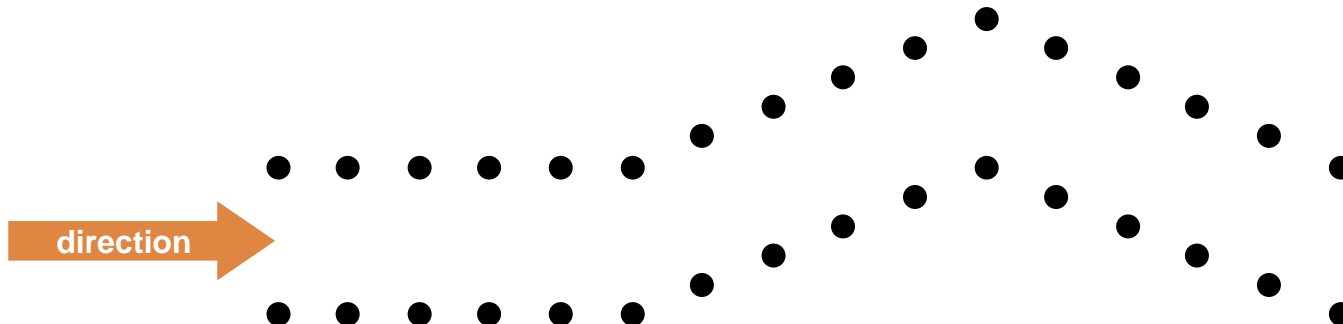
For example, if your gate width is 20 feet the distance between gates would be 60 feet or greater



Miniature Road Courses

Ratio of gate width to gate spacing should be 2 to 1 or less.

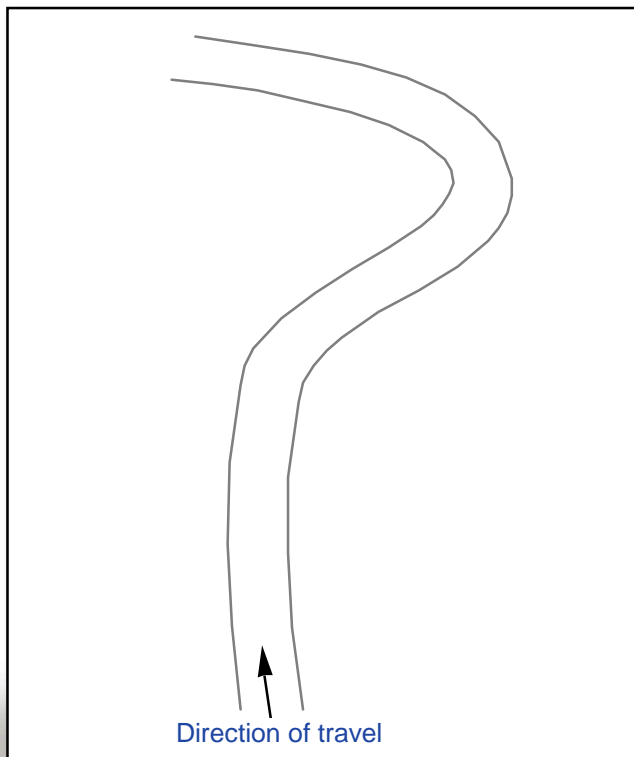
For example, if your gate width is 20 feet, the distance between gates would be 10 feet or less



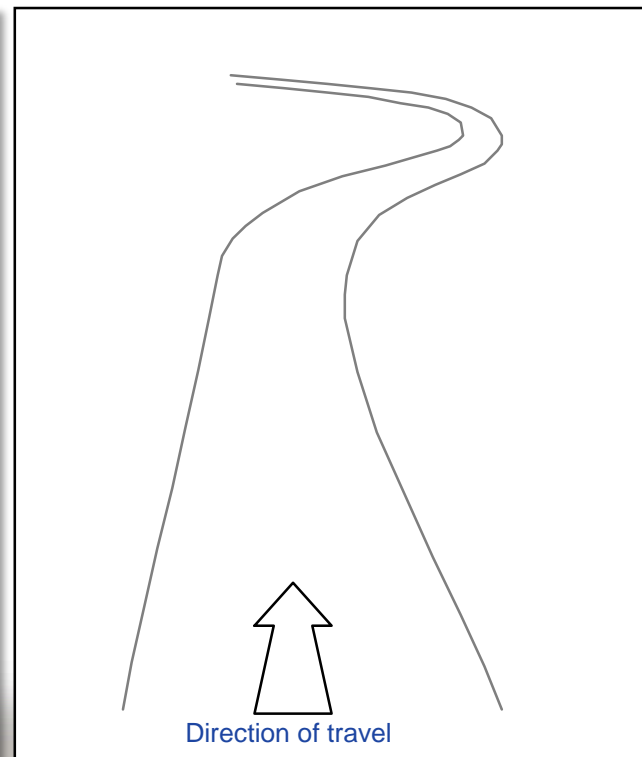
Plan and Perspective views

- 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



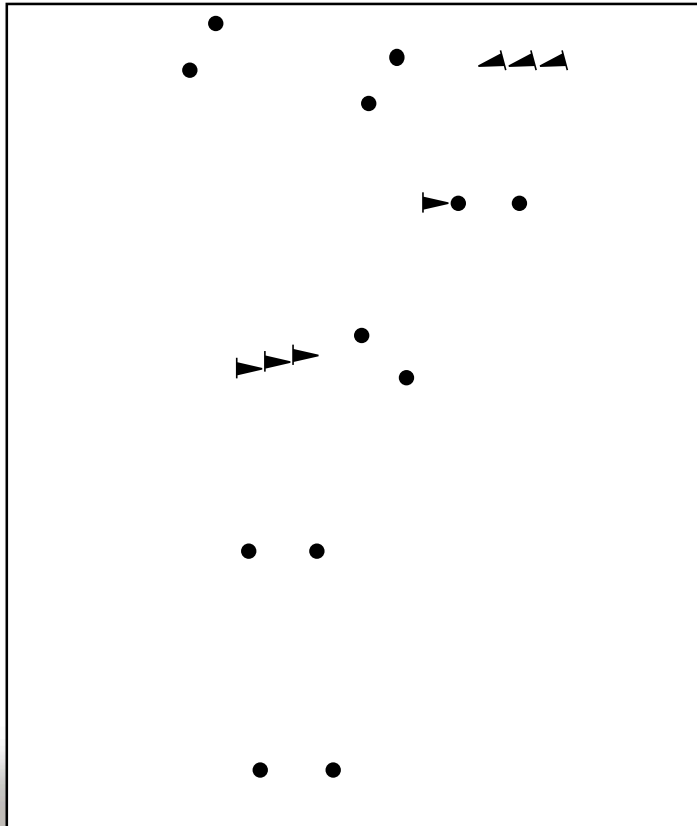
Perspective View



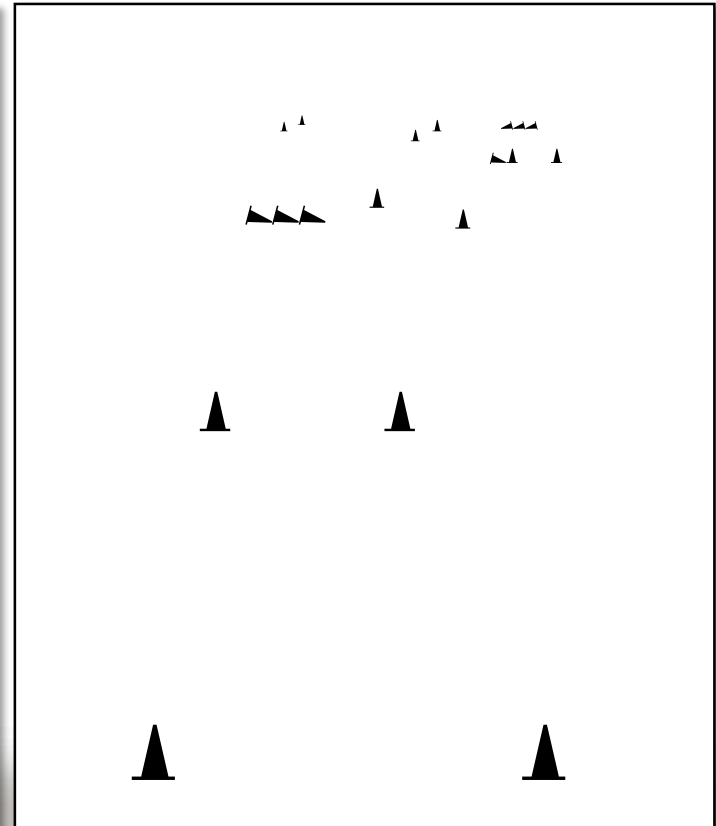
Gates and Pointers

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

Plan View



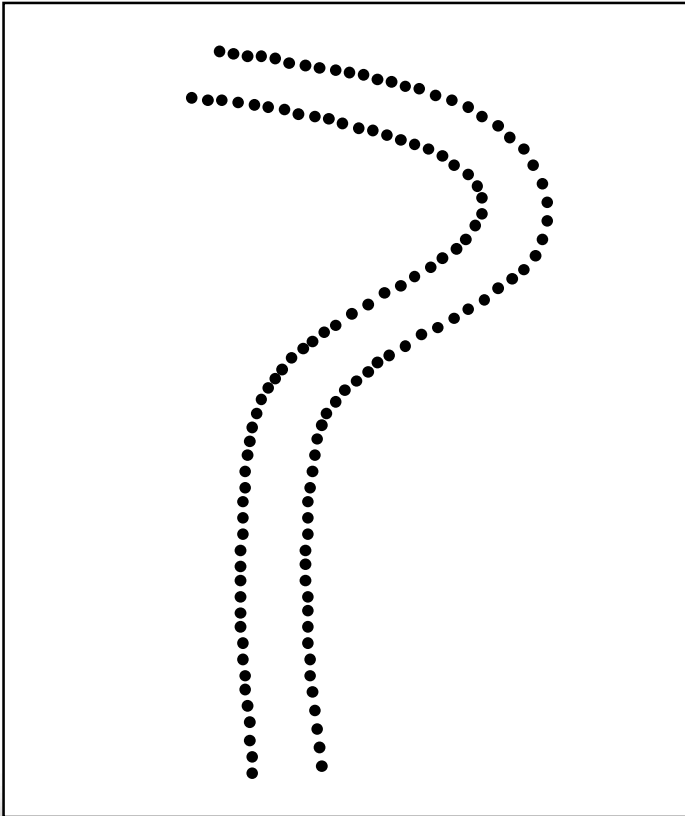
Perspective View



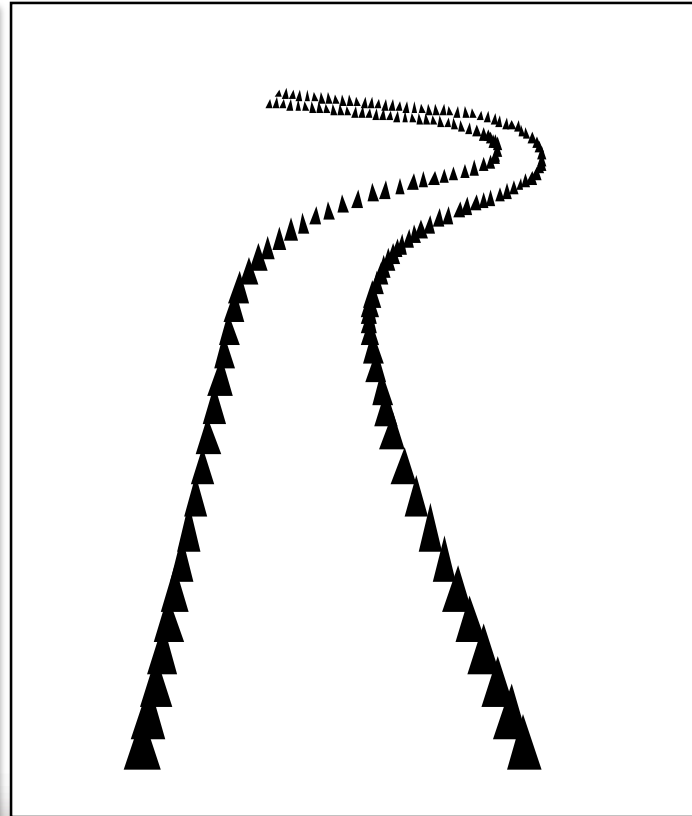
Wall-o-Cones or Miniature Road Course (MRC)

- 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



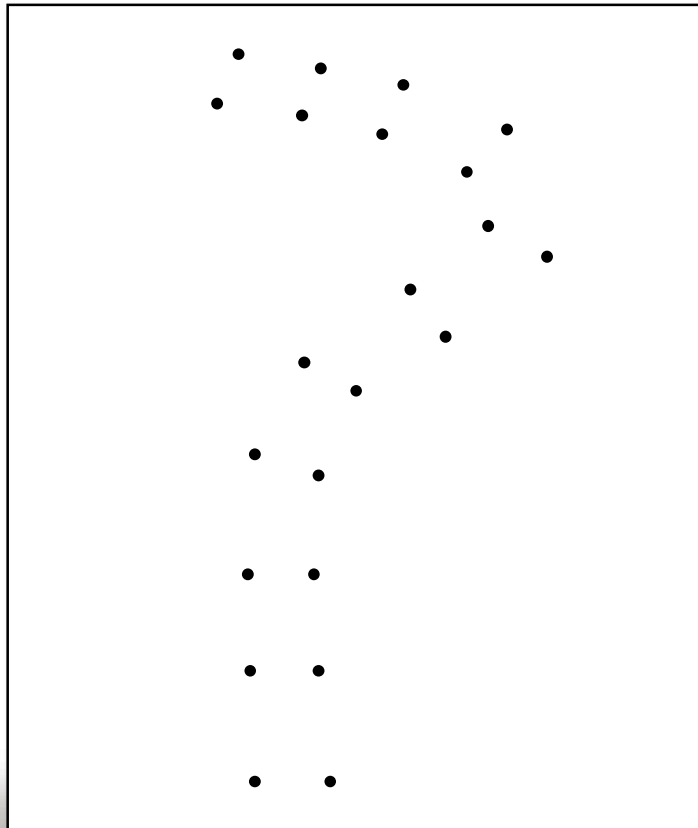
Perspective View



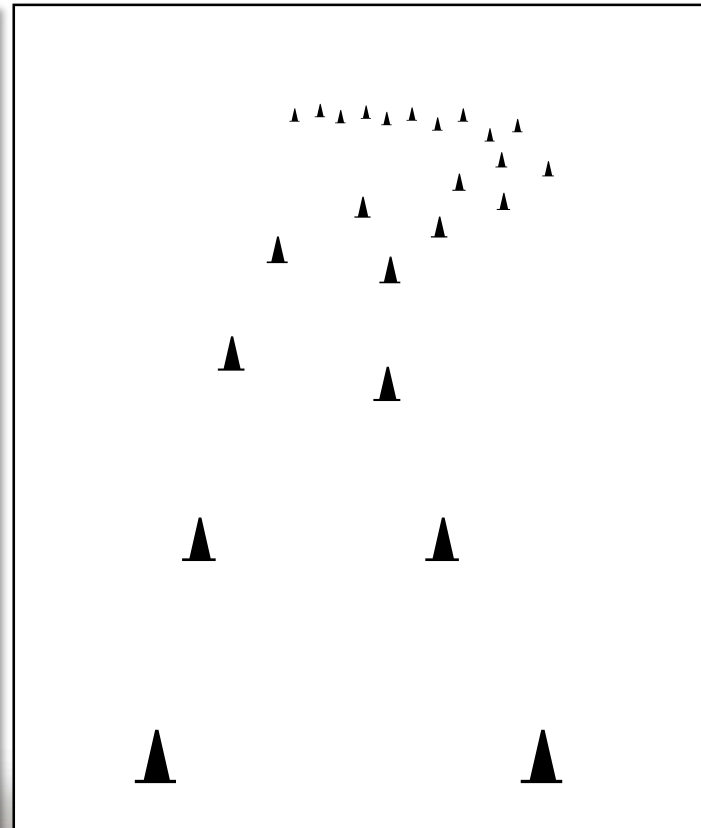
the Dreaded “Sea of Pylons”

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



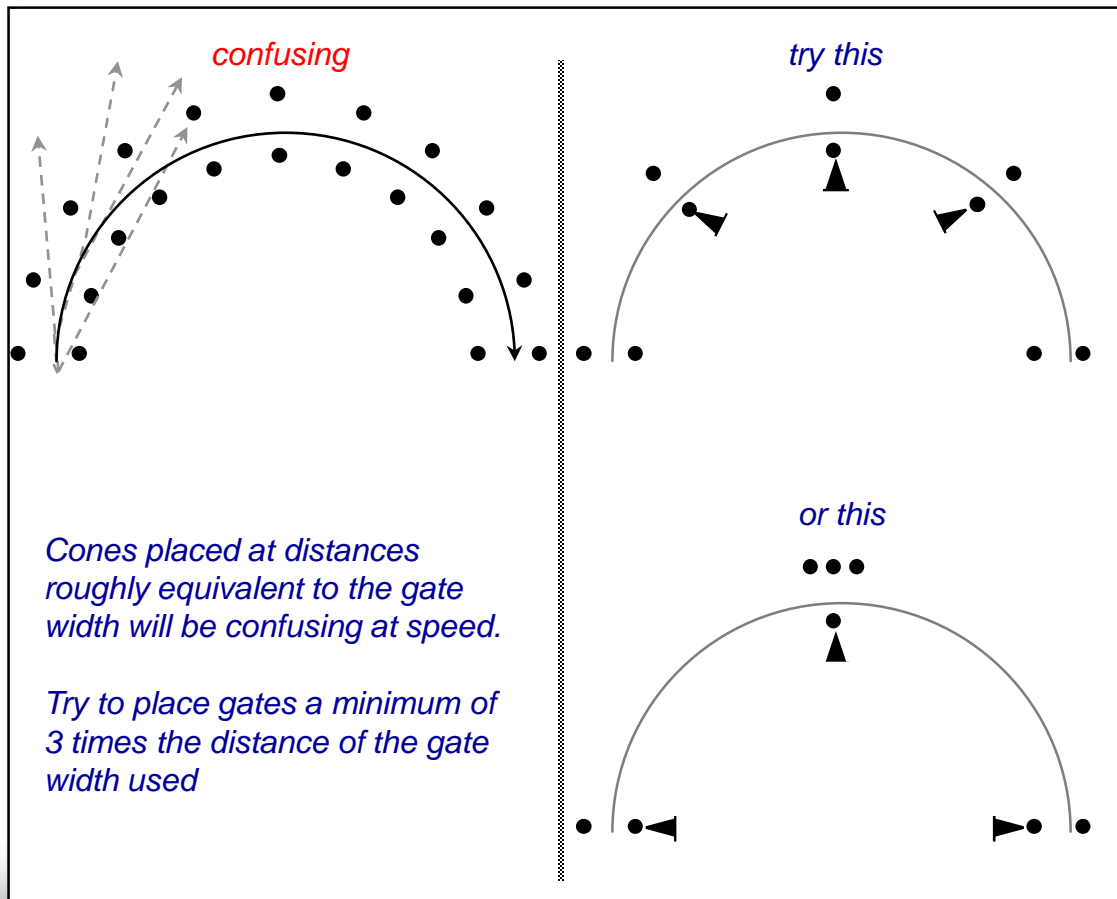
Perspective View



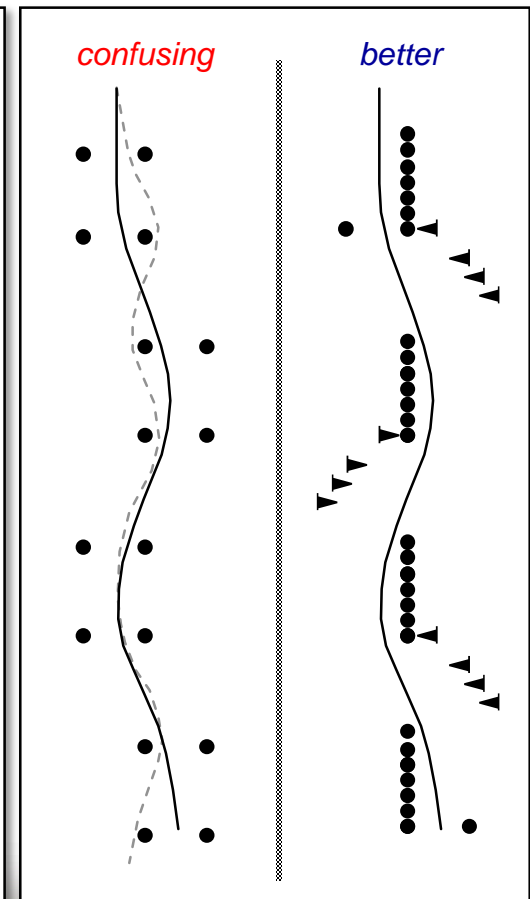
More Examples of “Cone Hell”

Other examples that demonstrate the importance of gate spacing

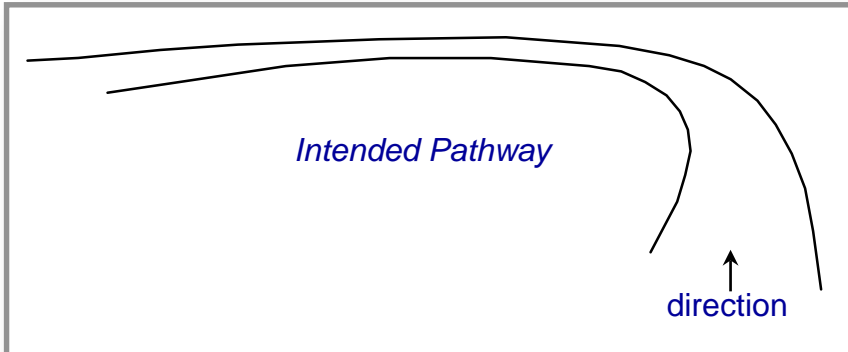
Sweeper



Lane Change

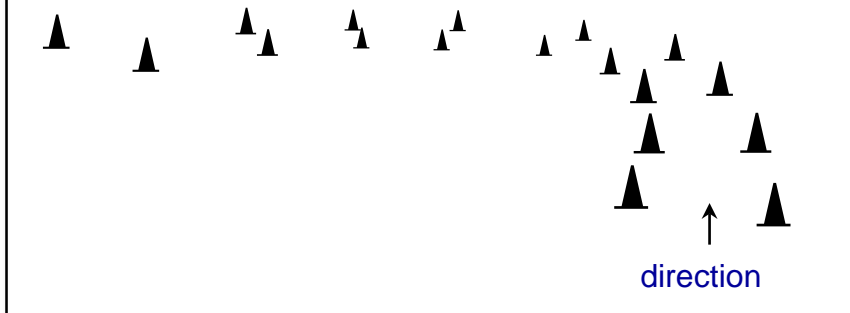


Sweeper - Perspective View

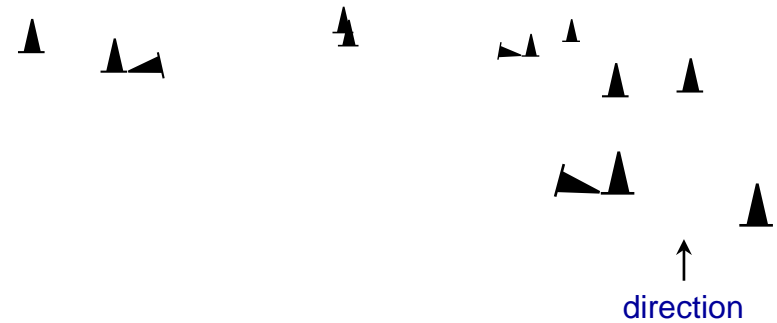


could be confusing

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



try this

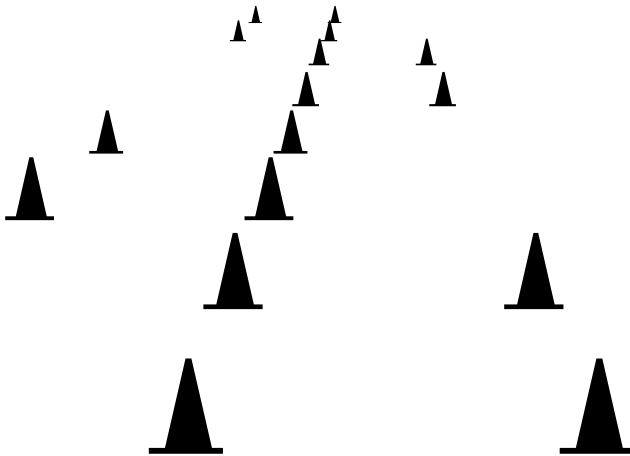


or this

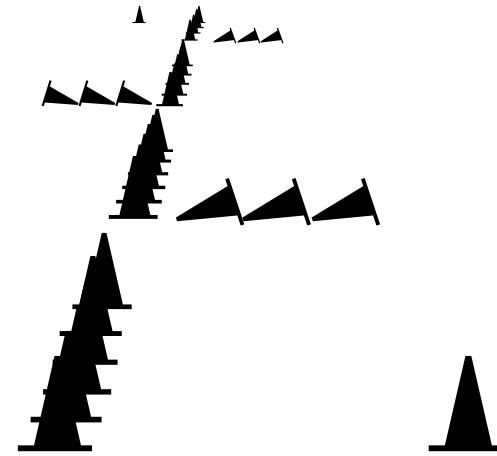


Lane Change Perspective View

sea of cones

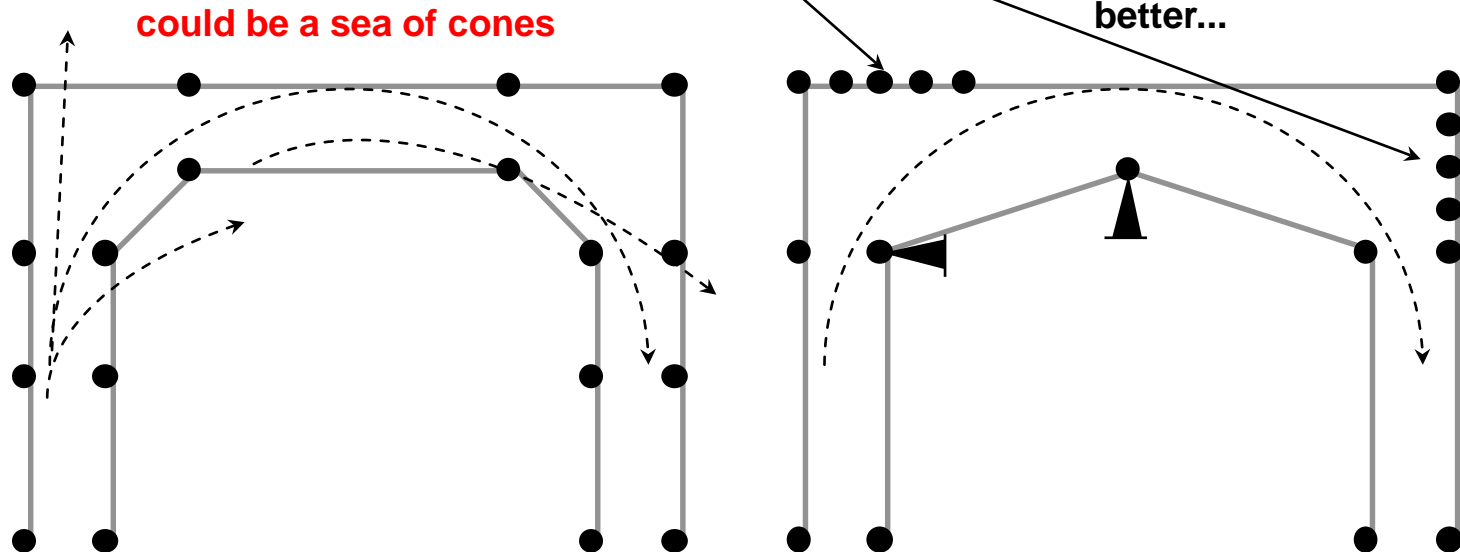


better



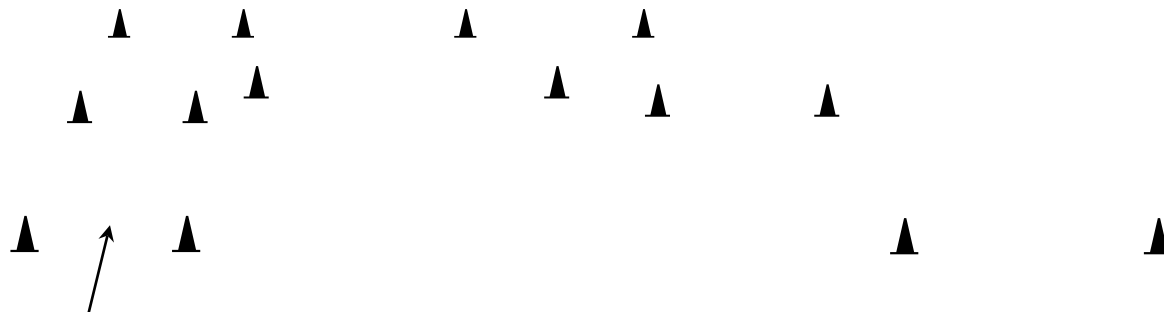
Box Turns

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

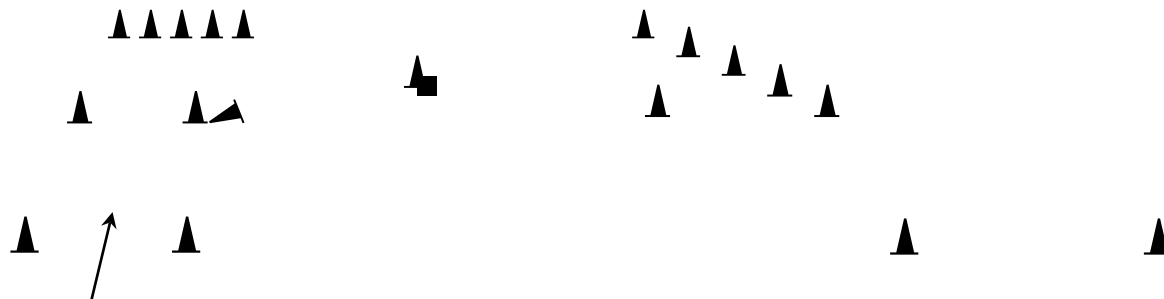


Box Turns Perspective View

Sea of cones



Better...



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)
 - Spectator areas
 - Timing vehicle/trailer/tent
 - Waiver patrol points
 - Registration
 - Finish placement/run-out
 - Pit areas
 - Technical inspection
 - Grid
 - Number of cones

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

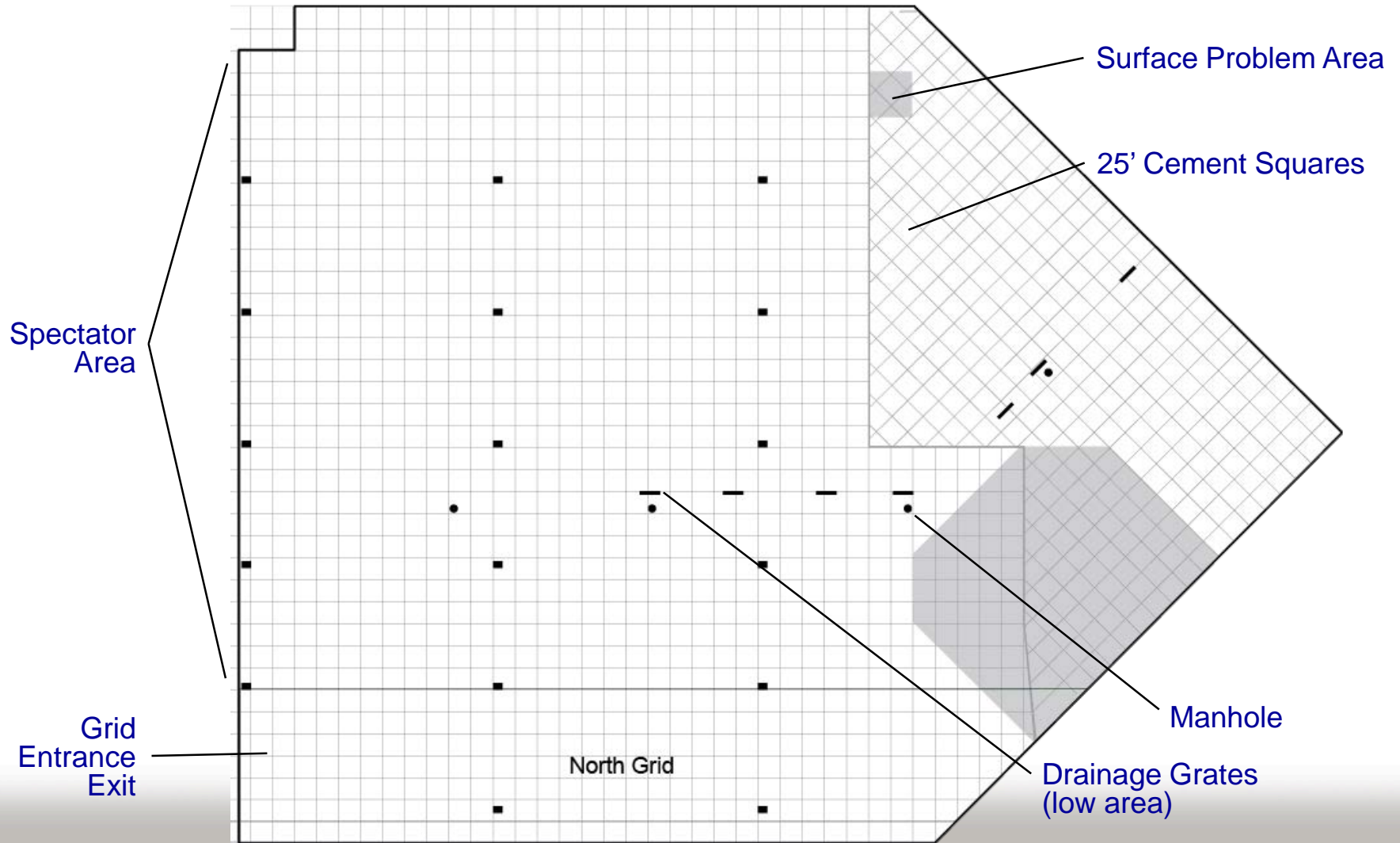
What We Care About

- **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**

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

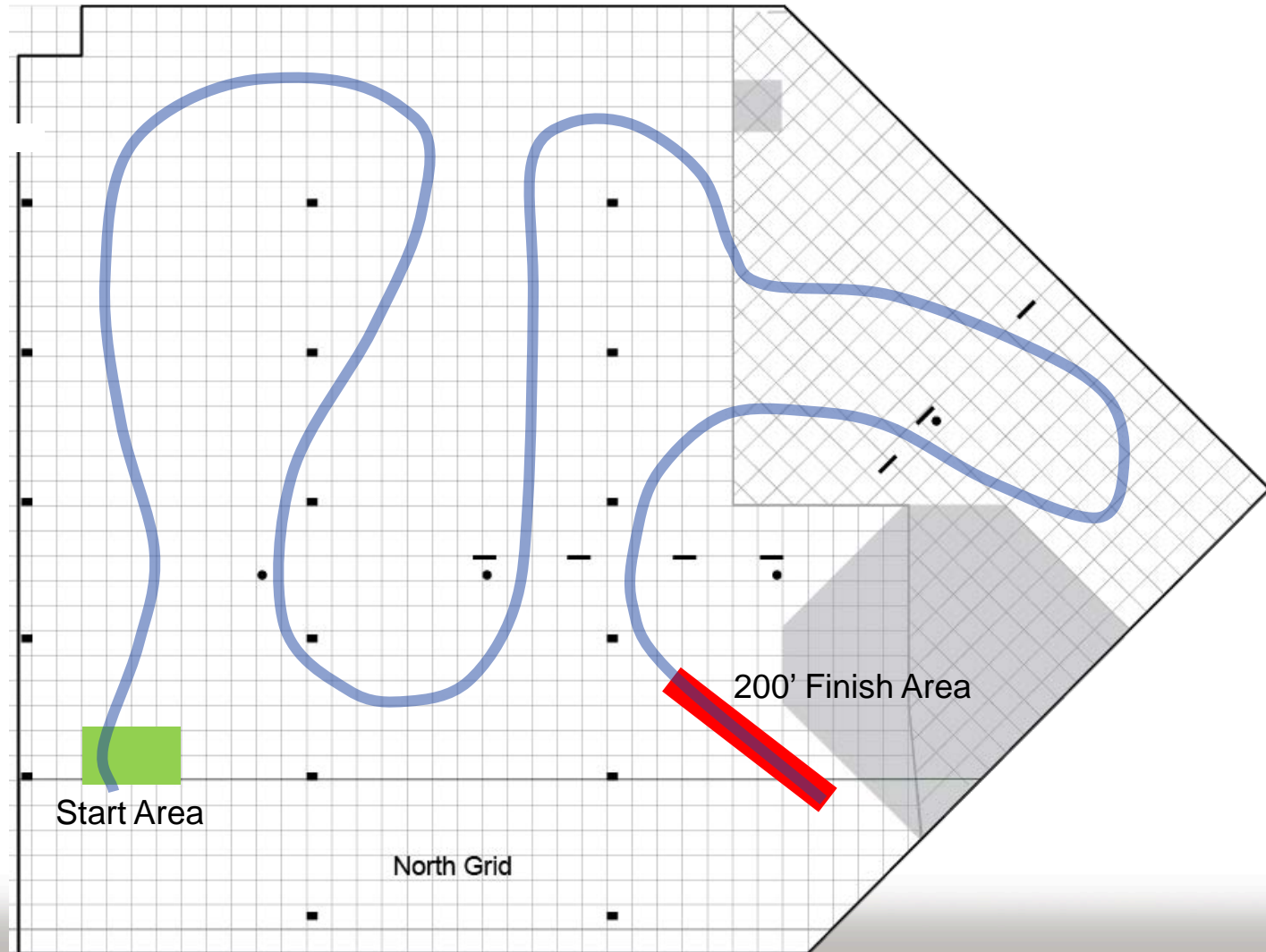
Scale Map of the Topeka North Course Area



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

So You Have a Blank Piece of Paper
Course Design and Event Setup
Example of a sketch

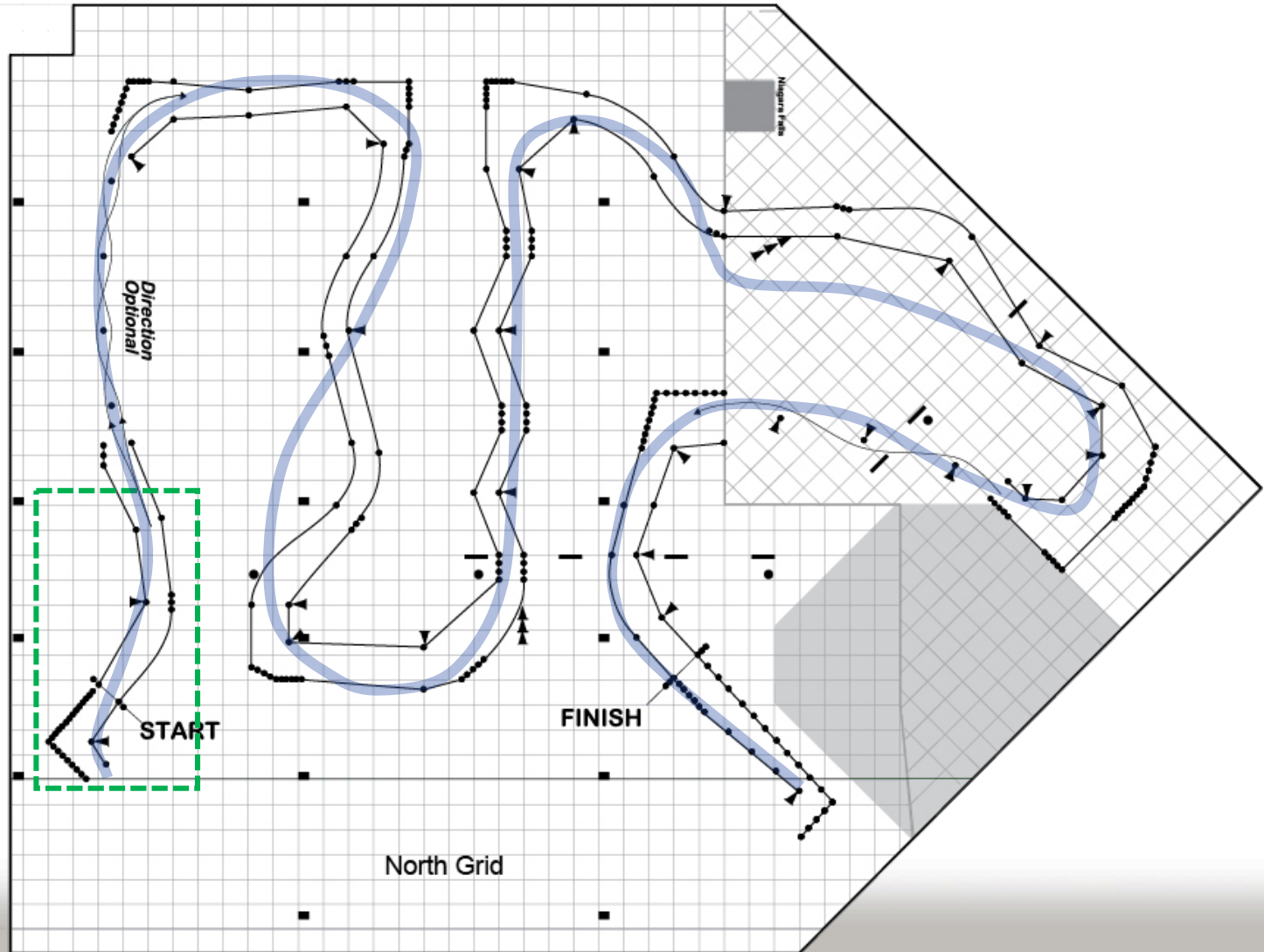


Finalizing the Design

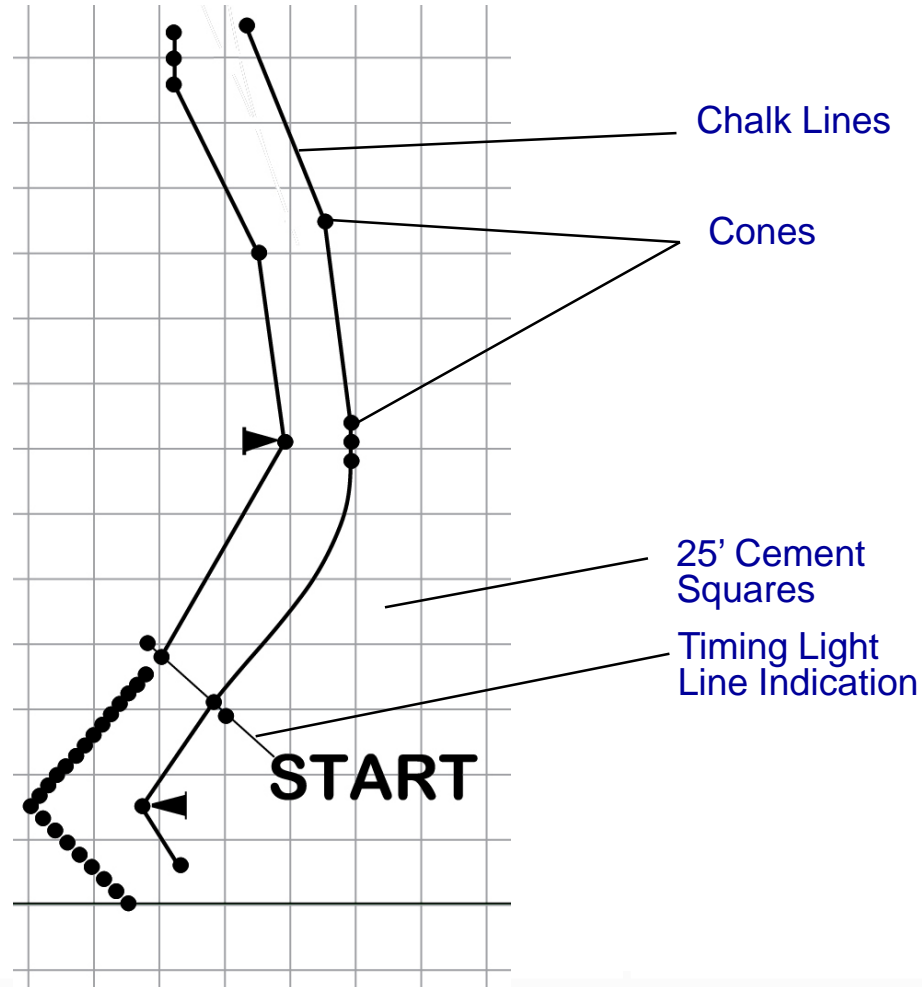
- Choose a **variety** of different types of maneuvers and features
 - **Make a list** of the desired elements
 - Decide which portions of that route **lend themselves** to each of the listed elements
- Pick the elements that seem the best for your pathway and fill them in
 - **Adjust** turn radii and 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

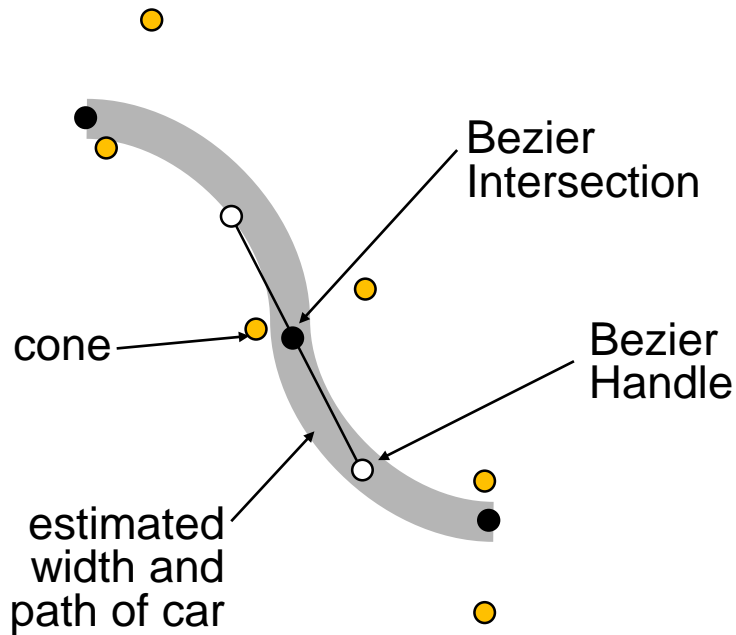


Course Design and Event Setup

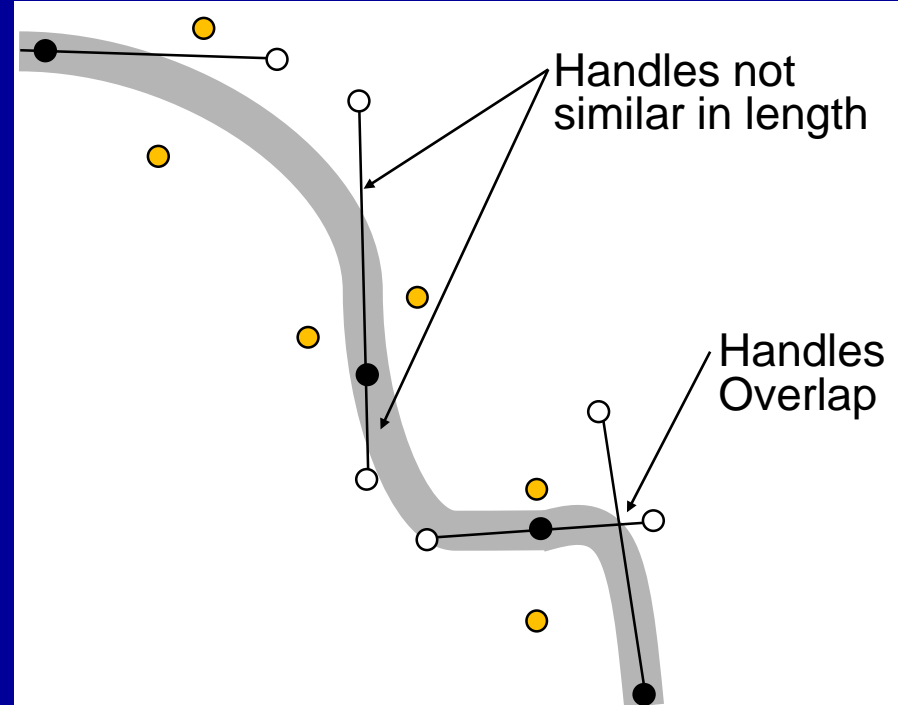
Computer Design Analysis

- 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

So You Have a Blank Piece of Paper

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**

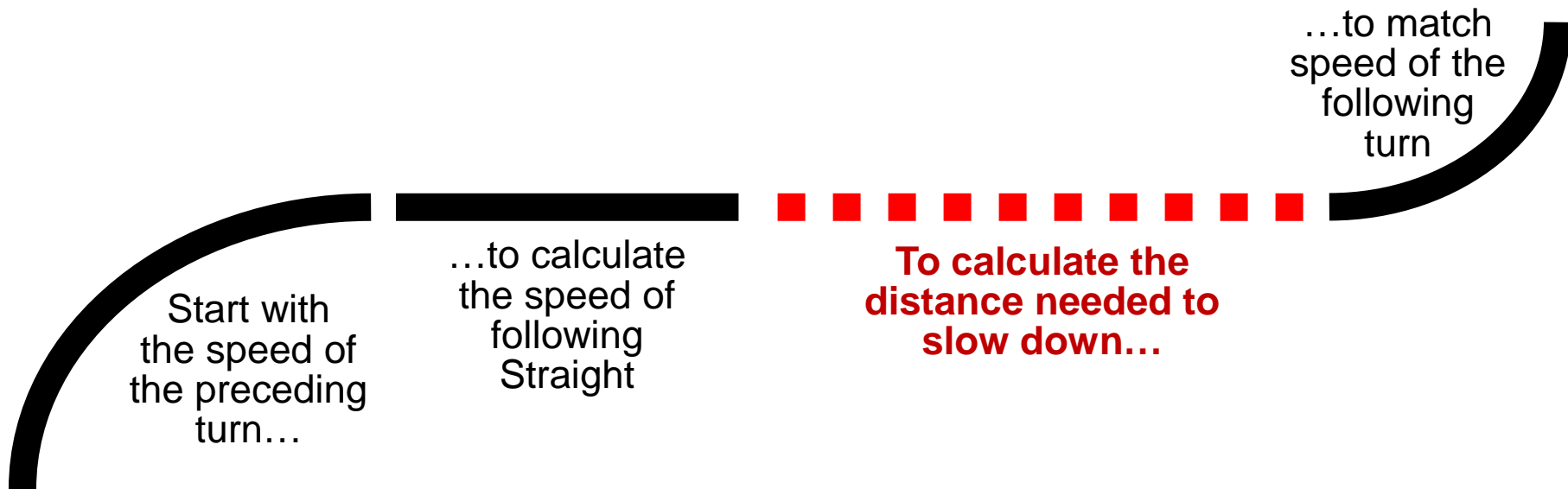
• Braking distances

- 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 braking effort on street tires)

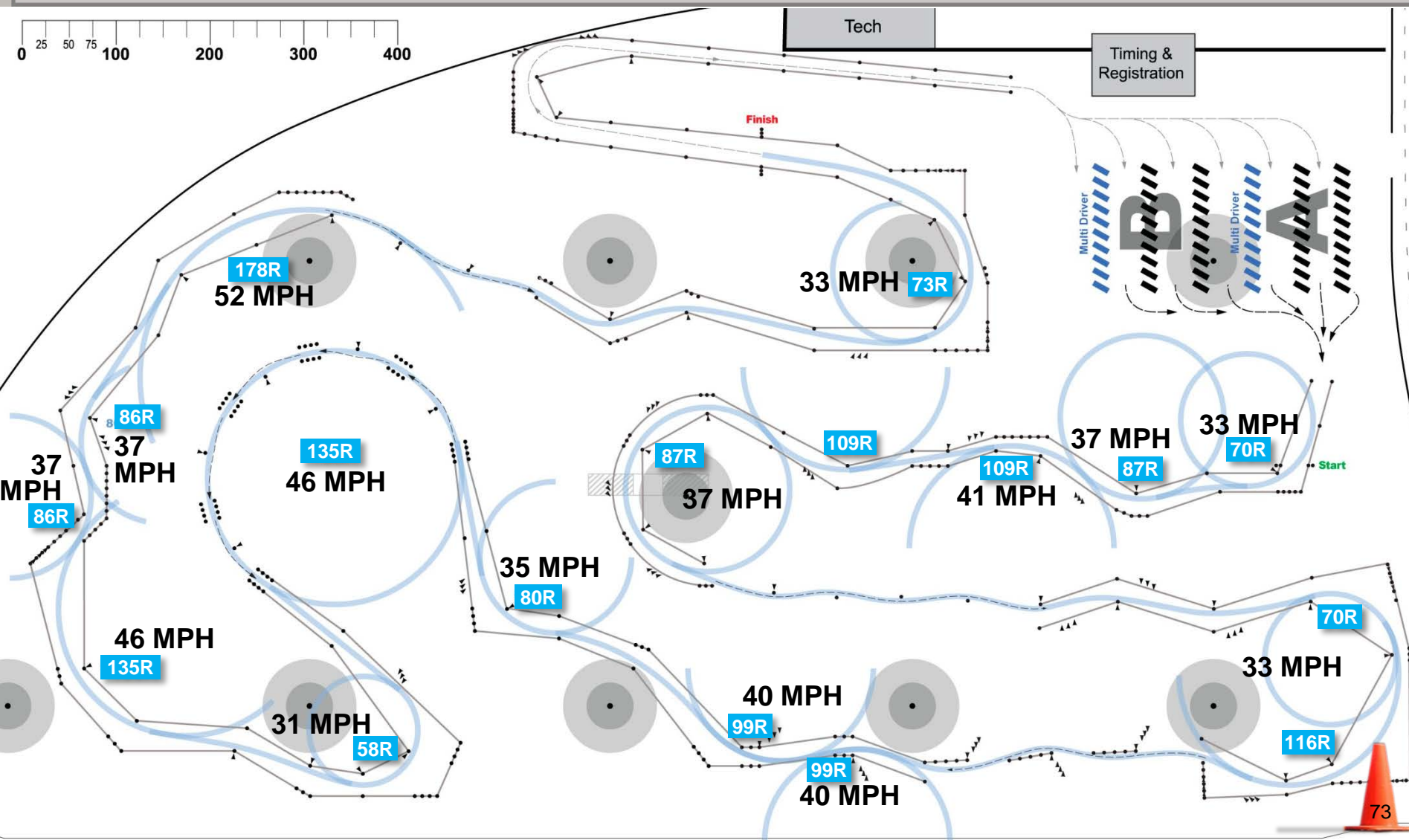
	Starting Speed	Target Speed	Needed Distance
Acceleration Section	35	65	191
Braking Section	65	40	110

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



Flow Analysis



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 lights*
 - 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

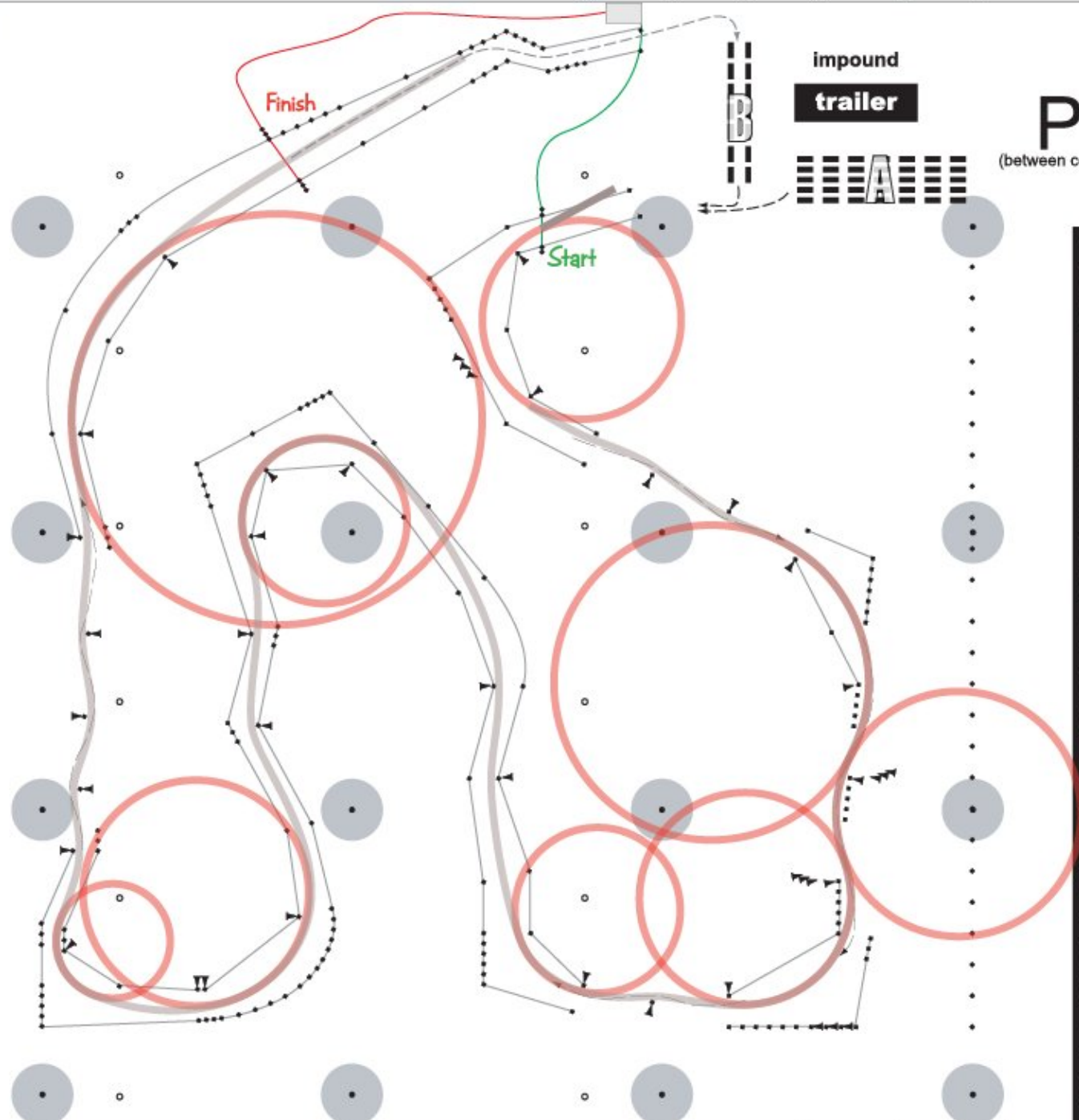
Designing a Safe Finish Checklist

- **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**



impound
trailer

B

A

Pits
(between course and road)

Seagull Target Practice

Precision Racing Org
Championship Series

Event #3
LaMarque, TX

Dog Track
Facility

Curb and Chain link fence

Timing Truck

~200'

Finish

Grid

Light pole

Light pole

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

Whats Wrong With this Finish?

Light pole

Curb and Chain link fence

Curb and fence too close for speed of finish

~200'

Finish

Timing Truck

Timing truck too close

Grid

Light pole

Light pole

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

- **Turn too fast for length of finish (does not slow car)**

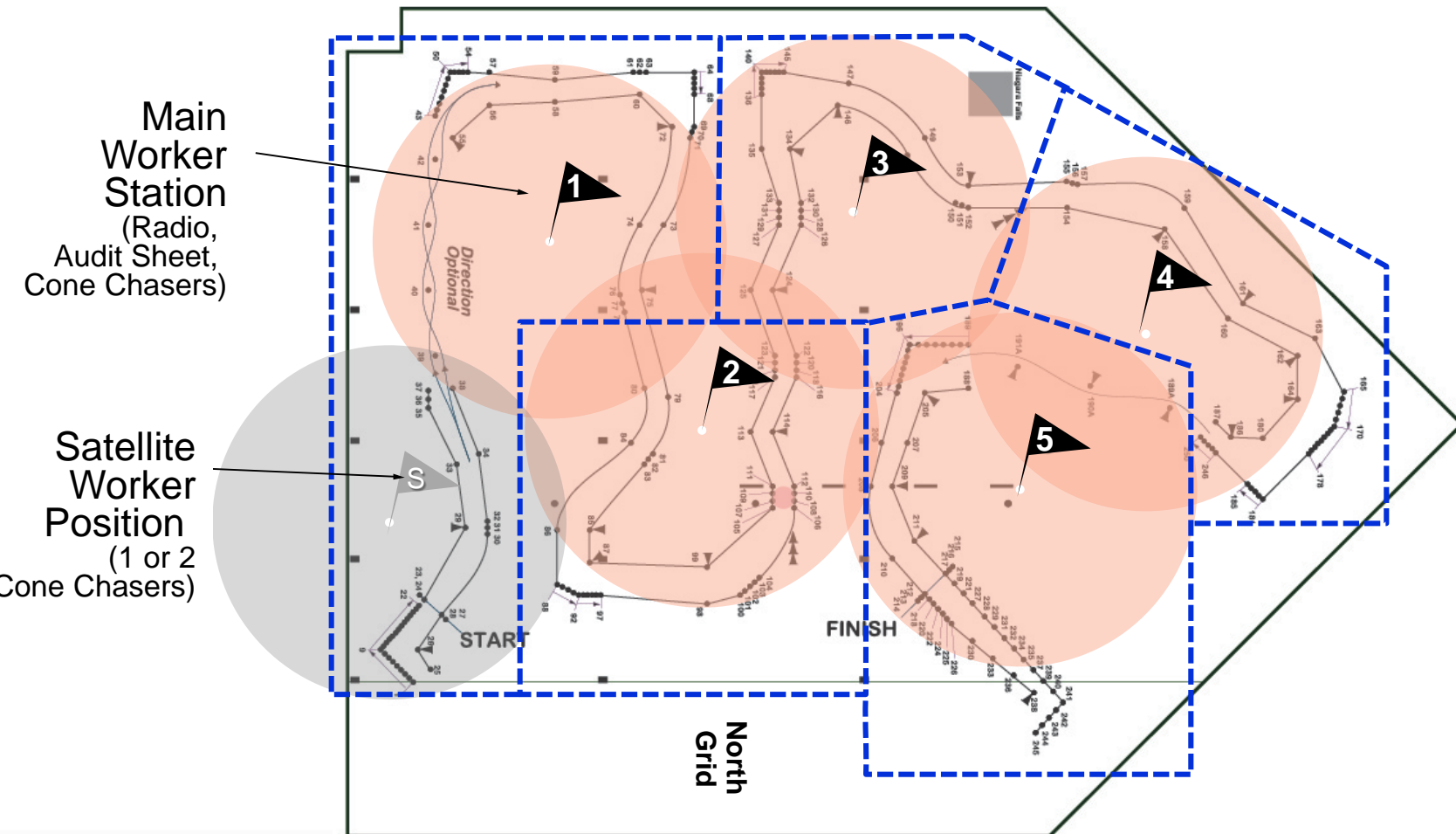
- 55 mph turn + 100' straight = ~68mph at the lights on DOT Race Tires

- Stopping distance ~200' in a 200' stop box – and no one stops right at the lights...

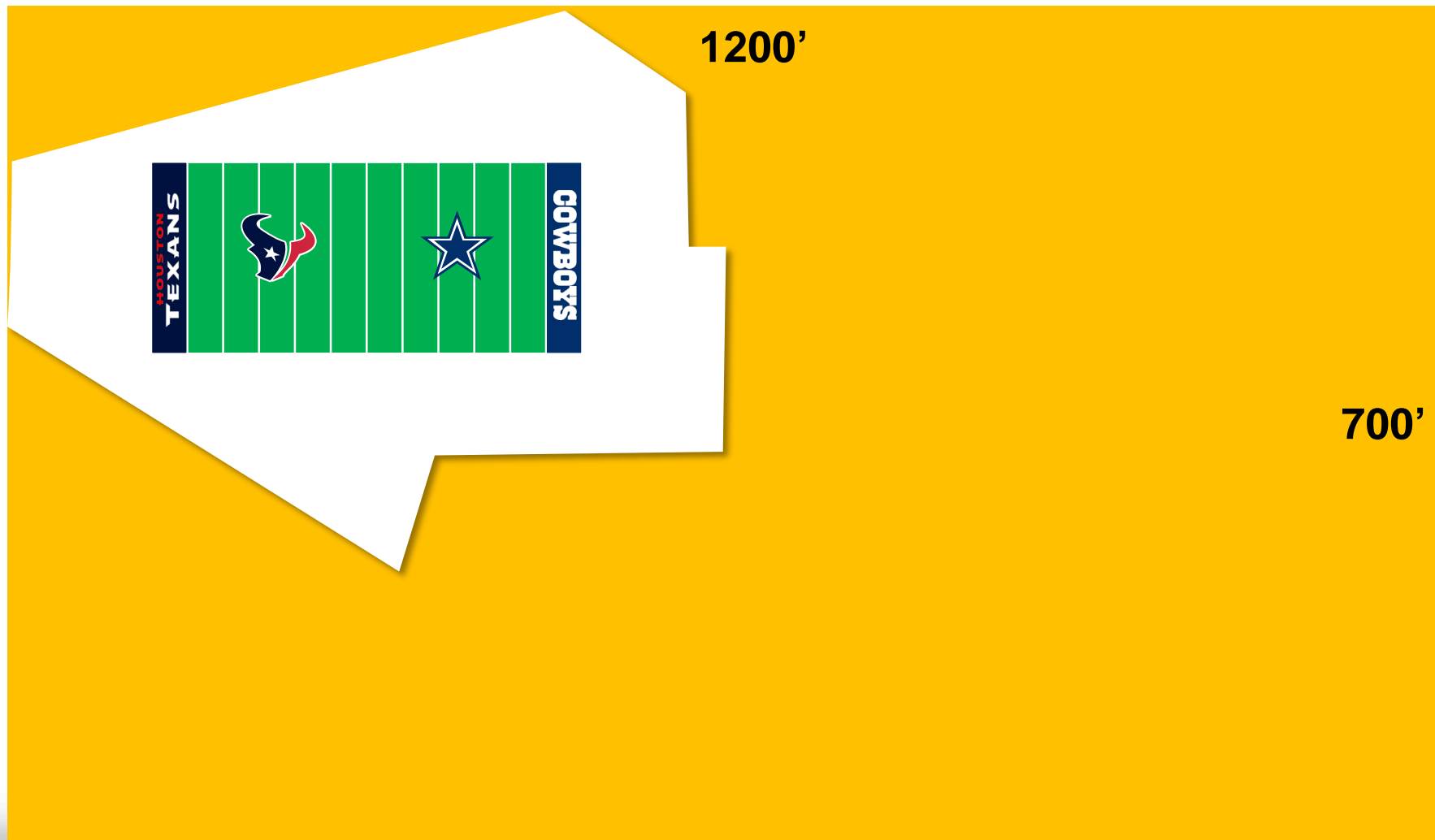
Light pole

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	311	
20	17	0	12	26	42	62	88	118	149	182	228	277	330	
25	26	9	0	14	31	50	77	107	138	171	218	268	330	
30	38	21	11	0	17	36	63	94	125	158	206	257	320	
35	51	34	25	14	0	19	47	78	109	143	191	243	307	
40	67	50	41	29	16	0	28	59	91	125	173	226	291	
45	85	68	58	47	33	18	0	31	62	96	145	198	264	
50	104	88	78	67	53	38	20	0	31	65	114	167	234	
55	126	110	100	89	75	60	42	22	0	34	84	138	205	
60	150	134	124	113	99	83	66	46	24	0	50	105	173	
65	176	160	150	139	125	110	92	72	50	26	0	54	123	
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	

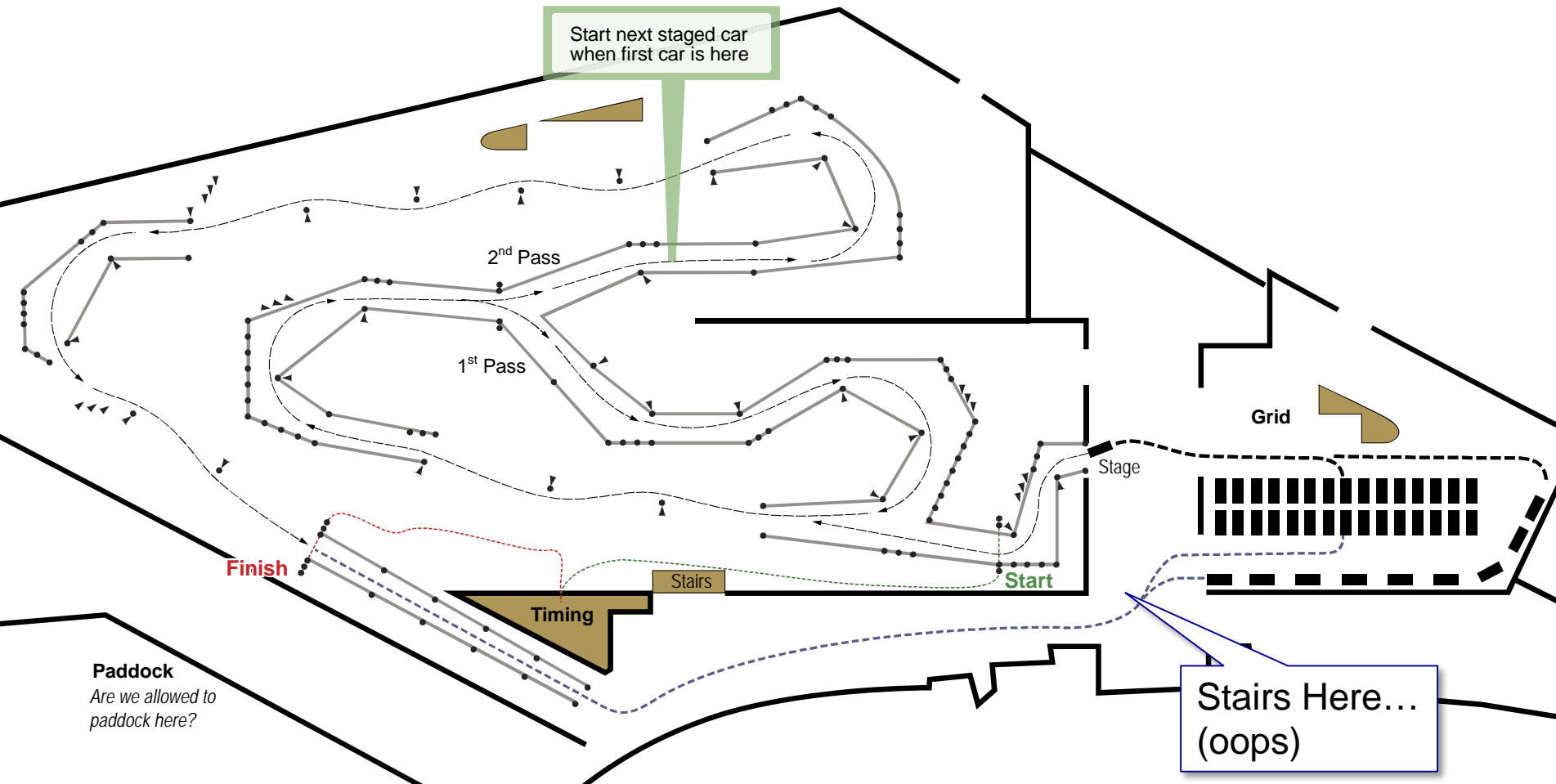
Placing Worker Stations



So You Have a Blank Piece of Paper
Small Or Odd Shaped Lot Utilization
Estadio Monumental vs.
SCCA Nationals East Course Area

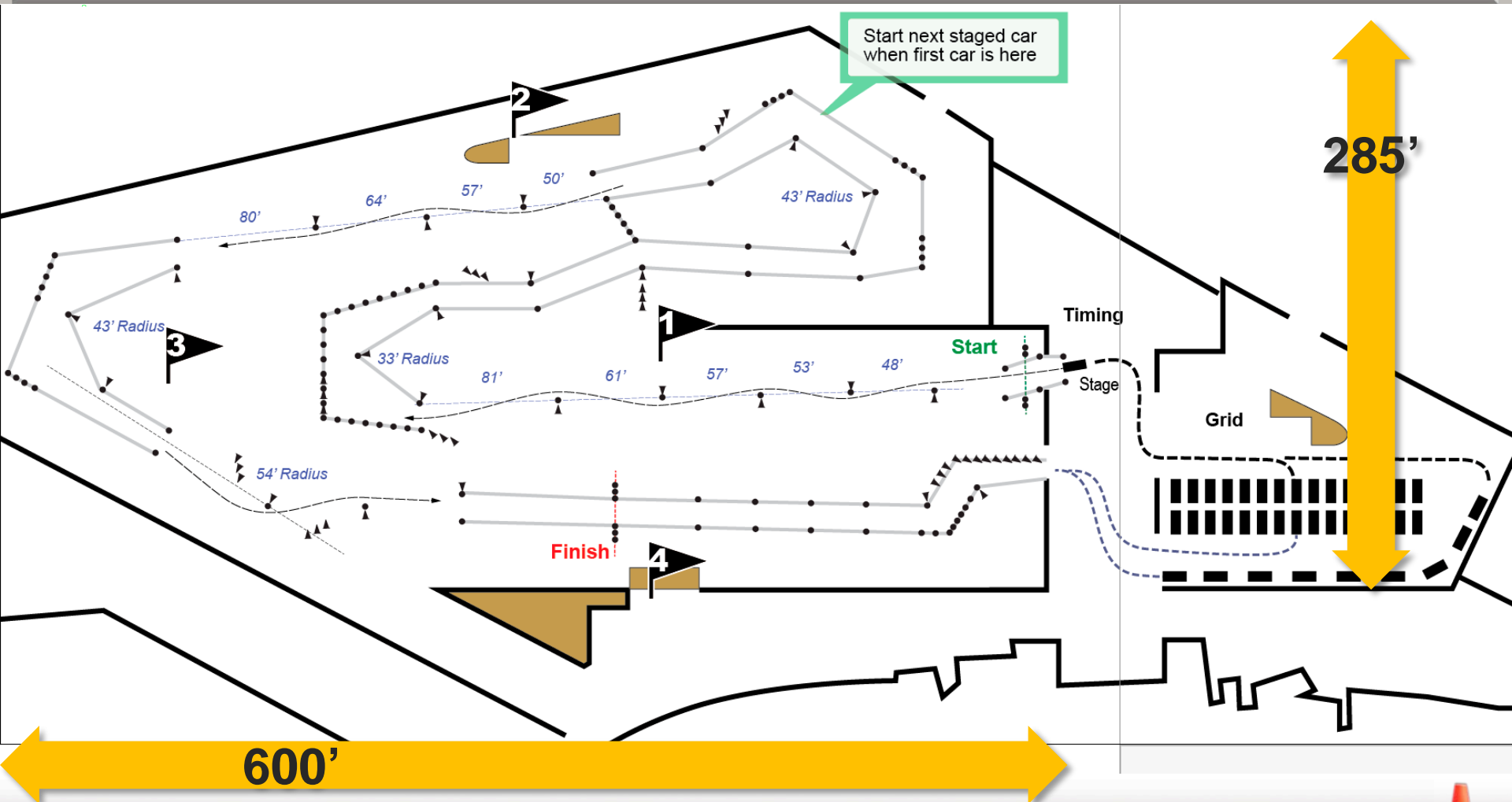


Small Or Odd Shaped Lot Utilization Estadio Monumental First Try



So You Have a Blank Piece of Paper

Small Or Odd Shaped Lot Utilization Estadio Monumental

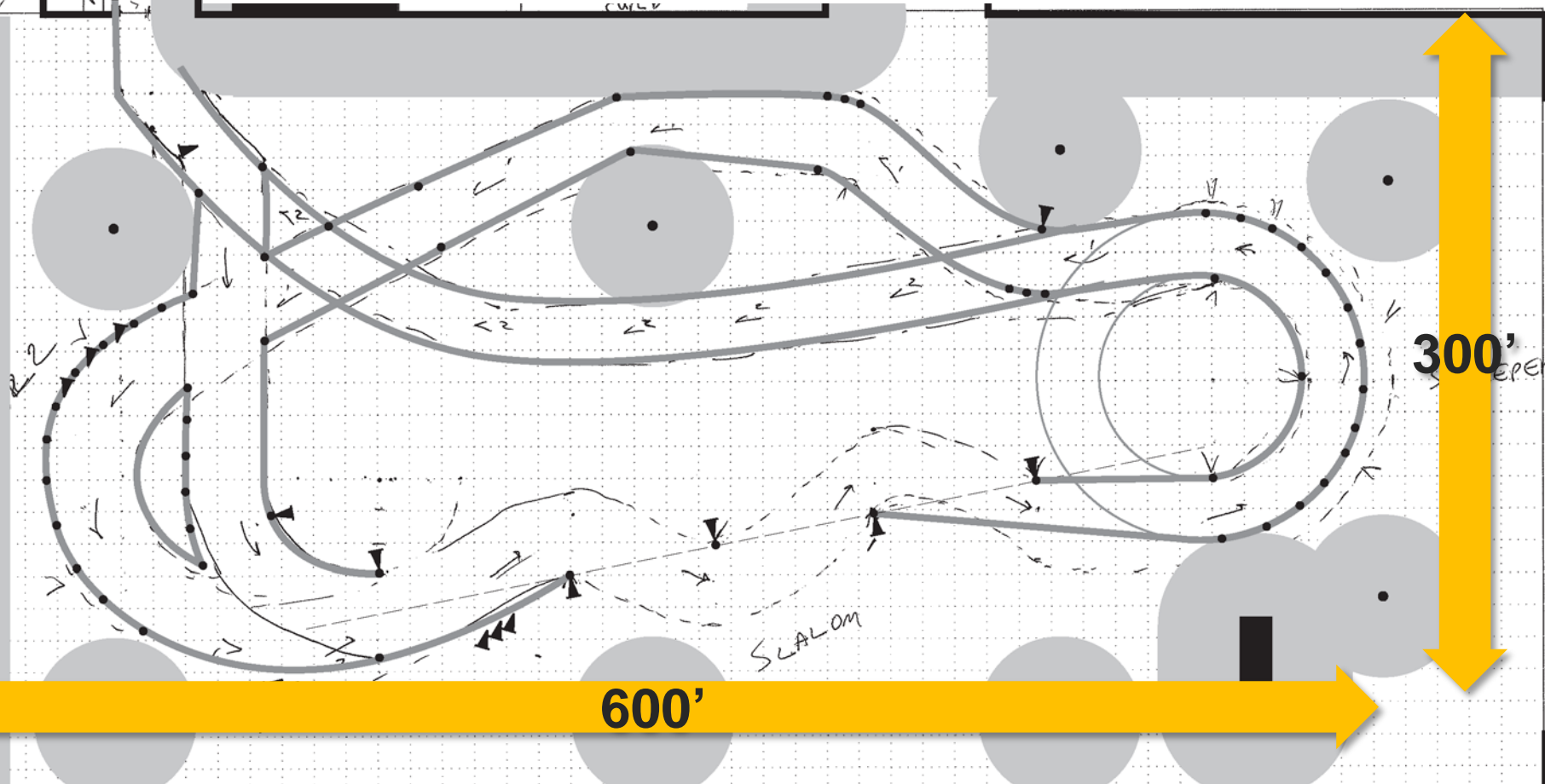


So You Have a Blank Piece of Paper
Small Or Odd Shaped Lot Utilization
Lumber Yard vs.
Solo Nationals East Course Area



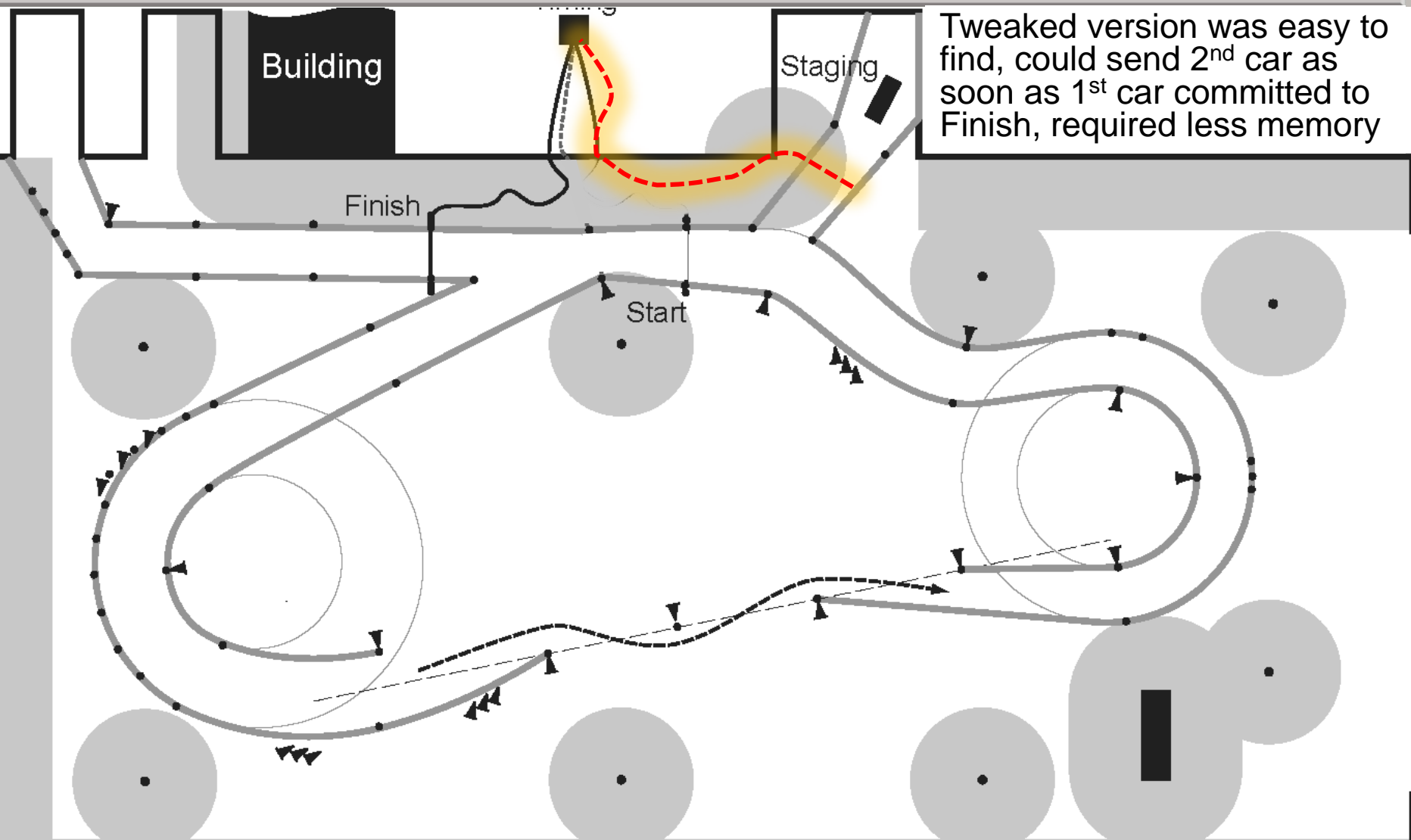
Small Or Odd Shaped Lot Utilization Lumber Yard Site

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.



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'

150'

600'

75'

Tower

Start

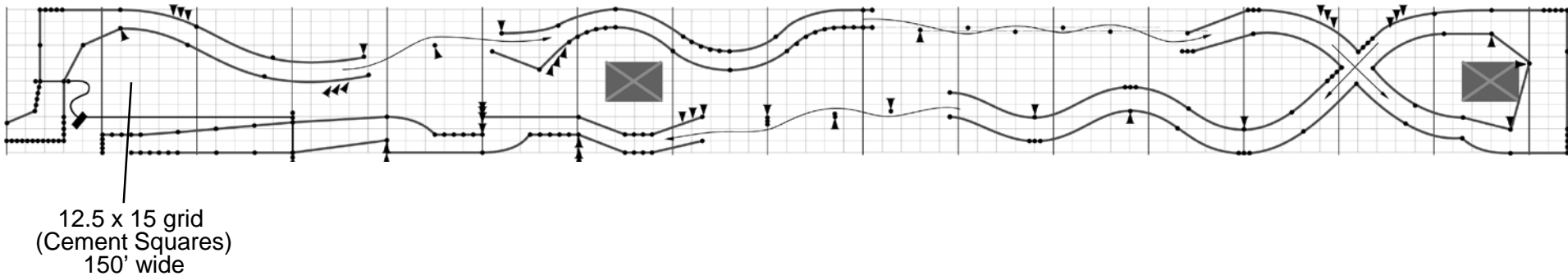
Finish

this road
not to scale

this road
not to scale

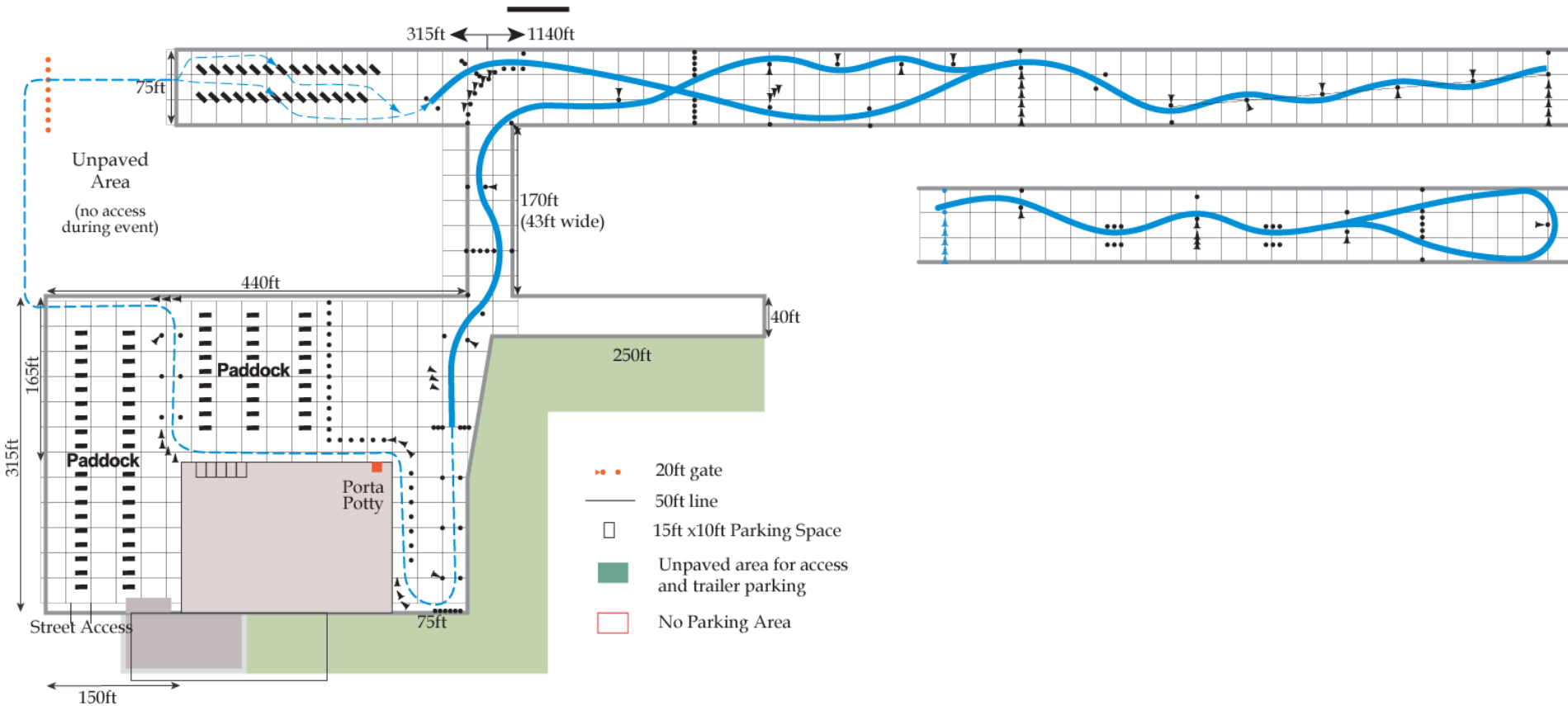


Long Skinny Sites

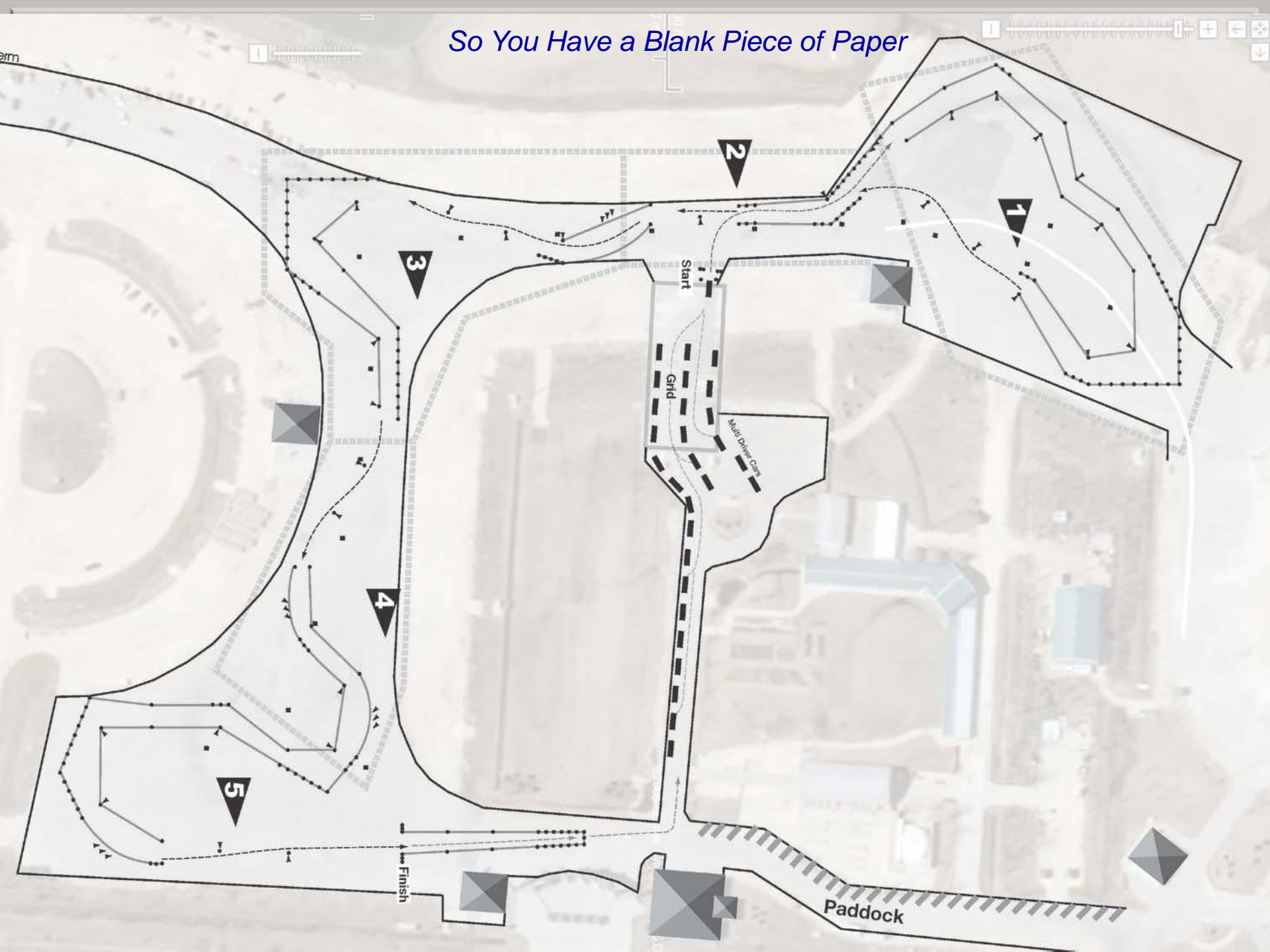


- **How about a “long and skinny” event site?**
 - Avoid slalom down, 180° turn, slalom back
 - Balance between slaloms, sweeping turns, and offset gates, just as you would in an open lot
 - You just have to be more creative to do so... 8^)

Other Difficult Shaped Sites

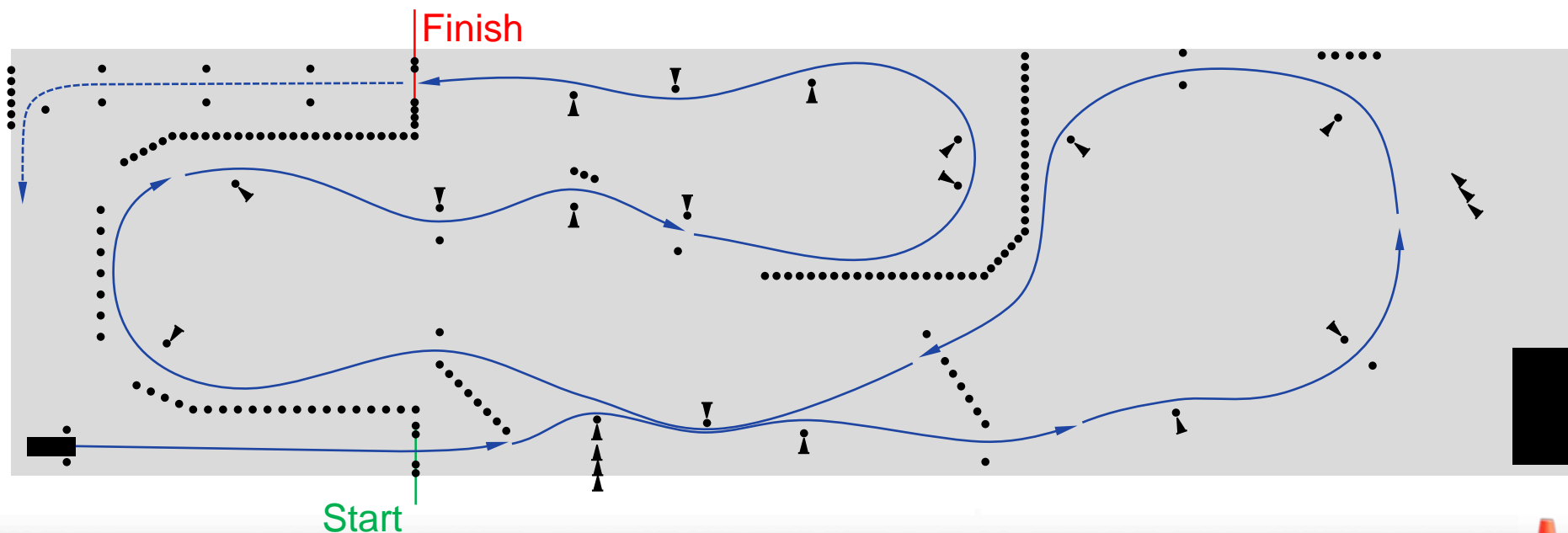


So You Have a Blank Piece of Paper



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



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**
- **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
 - 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**

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.)
Option.....	Dodge Daytona IROC R/T.
	Talon TC

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	
Front, type/dia., in	Vented discs/10.9
Rear, type/dia., in	Vented discs/11.4
Standard tires	Standard
Wheel	
Front	
Rear	

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

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. aid mirrors, air cond (\$850), power sun-
 roof (\$800), ABS (\$700), CD player (est. \$450). Call
 emissions \$711. Power steering wheel \$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 GIBSON

SCALE: 15 in (254 mm) DIVISIONS
DRAWING BY BILL GIBSON

ENGINE

Type aluminum head & block
 Displacement 1.8 liter
 Bore x stroke 3.39 x 3.39 in
 Compression ratio 86.0 x 86.0 mm
 Valve train 9.5:1

DRIVETRAIN

Transmission 5-sp manual
 Gear Ratio Overall ratio (Rpm) Mph
 1st 3.16:1 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
 5th 0.76:1 3.16:1 **est (6150) 125**
 Final drive ratio 4.18:1
 0-100 ft 2950

ACCELERATION

Time to speed Seconds
 0-30 mph 2.7
 0-40 mph 3.4
 0-60 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**
 0-1320 ft (¼ mi) **87.0 mph**

ACCURACY

.....

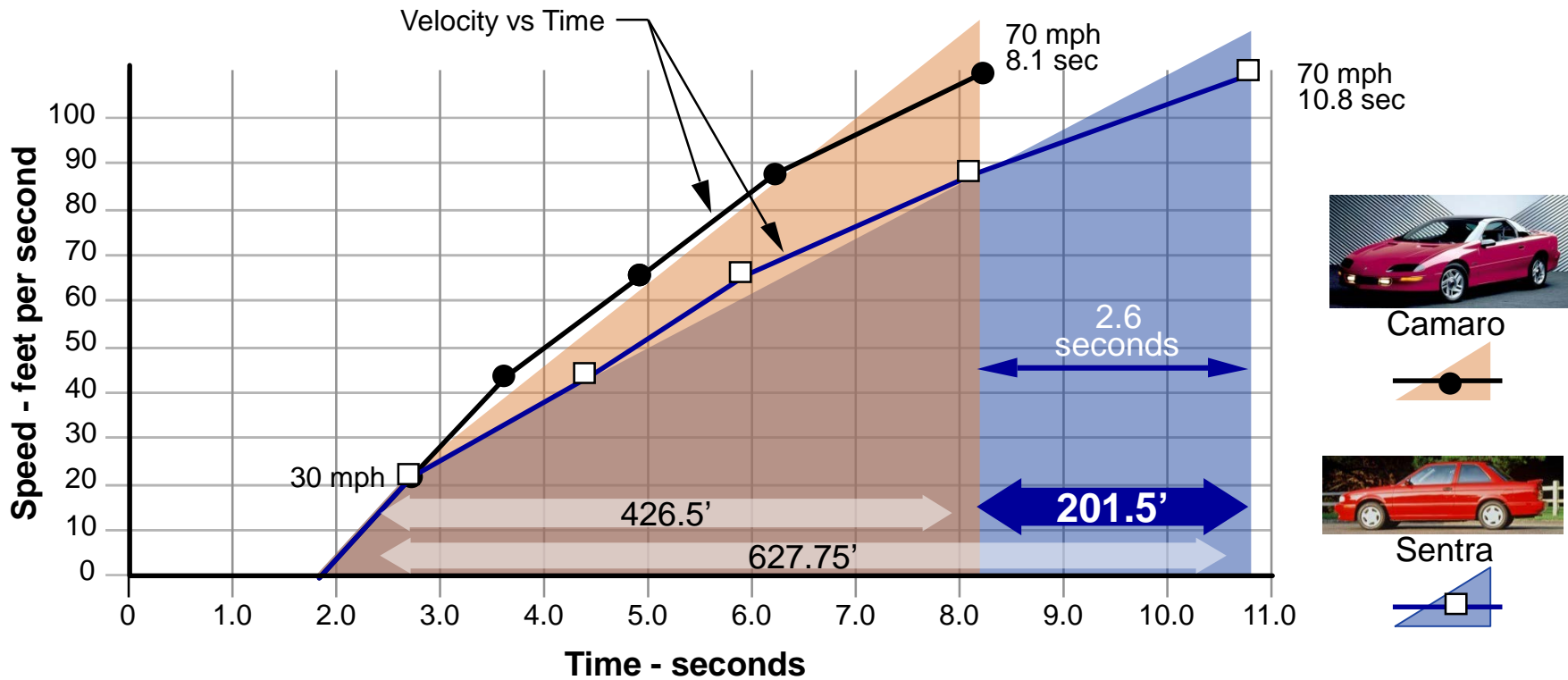
ADAPTATIONS

.....

BRACING

.....

Camaro and Sentra Velocity vs. Time



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



Why Do We Care? (continued)

- 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

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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
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rogerthereal@entouch.net
- **Complete Course Design Booklet**
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 - Then scroll to the bottom of the page and select **Solo Course Design Manual**