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)
• 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...

Do Not

• Get them lost or make them hit cones!
  • DO NOT include too many pylons creating effect known as the “Sea of Pylons”
  • DO NOT space pylons the same or similar distance as the gate width
  • DO NOT place the next gate out of their line of site
  • DO NOT fail to line the course (when possible)
  • DO NOT place a cone(s) with the only intent of “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
How does a Commercial Artist Please the Customer?

• 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

• After the peer review, look over and analyze their comments, and then implement any that you feel improve your course design
  • Be **true to your basic concept** - put your own style into their suggestion if you wish; that is the reason you ask to understand the ‘hows and whys’
  • Remember: The great thing about **advice** is that you don’t have to take it - and you might actually 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 a **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 a particular element just because it is an “old favorite” of yours
  - **Try to ‘eaves drop’ for comments about the course**
    - This is a good way to get 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 like it; those that didn’t tend not to...
• 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

• Number and frequency of pylons hit
  • The goal is zero
  • Acceptable is 1 car in 10 hitting any; no more than 3 for any one car

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?**
    - Taking a usual maneuver and changing to make it *more interesting* - not to make it painful!
    - Setting usual maneuvers in a *visually different* manner
    - Including a *variety* and number of different types of *turns* and transients and a sufficient input density
    - Placing enough challenge into a course *without* making it “painful”
    - Utilizing the “punish/reward” or “sacrifice/gain” concept
    - Creating situations where the driver must *analyze the course* carefully to find the fast line(s) - so that those with the right amount of skill, aggression, experience and discipline will be rewarded
    - Use *chalk lines* in a variety of visually interesting and helpful ways

- Be creative and innovative but avoid the bizarre
  - **When you come up with a 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
• 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/perpendicular 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 proper entry into the first part of the combination in order to drive through the entire combination quickly
• Provide sufficient input density
  • Input density is a measure of direction-changing inputs which the driver must give to the car to negotiate the course divided by the length of the course - the following is only a guideline (nothing is “black and white”)
    • Good input density would have about 20 to 35 inputs over a distance of approximately 3/4 mile
    • A less interesting course will have only 15 to 20 inputs for the same distance
      • Results of too little input density
        • A boring, non-challenging course to drive, where all times run are approximately the same
      • If input density is over 35 inputs for 3/4 mile, odds are that the design is too busy
        • Results of too great an input density
          • 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
10 Basic Concepts - Use Creativity

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
Version A; Basic 240 foot 5 cone slalom

Version B; Change for interest

Version C; Punish/Reward

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

- **Example 1**

- **Example 2**

- **Example 3**

You must also consider if the inclusion of your “creative” cone placement has reduced clarity of the course significantly.

In this case, 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 just following this slalom, **example 1** would be most appropriate. If there were not, examples 2 or 3 might be appropriate.
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 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.

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 responsibility comes with being Event Chairman), try to enlist someone who is truly interested in designing a course - you will still be ultimately responsible for the design, but will have “jobbed” it out 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.) deals with the Solo Course Design Rules found in Section 2.0 of your Solo rule book

• The obvious advantage to knowing the rules in Section 2.0 is that you will be more likely to create a design that will be considered a Solo type course, as well as a course that is acceptable to the assigned Safety Stewards and your competing peers

• The following are diagrams taken from some of the 2012 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
2.1.C The course boundary shall not normally pass closer than **25 feet** from solid objects.

2.1.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.*
2.1.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.*

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**Incorrect**

![Incorrect Diagram]

**O.K.**

![O.K. Diagram]
2.1.E  Negative cambered turns will be avoided if at all possible

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...) Be familiar with the terrain/grades of your course area so that you can purposely avoid designs that promote off-camber turns as is shown here in this exaggerated illustration.

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

Bad

Better

A sharp turn following a high speed entry into a tight slalom

A more gradual turn here following an increasing slalom
2.1.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 2.1.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

50'

75'

125'
5.) Make the Course Flow

• 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 generally refers to the manner adjacent sections of a course connect to each other
  • 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

“There’s no such thing as a car that can turn on a dime...”  K. C. Babb
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)s 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

Pylons which control the line or path if the vehicle, and therefore the speed, are “key cones”
Increasing the gate width without relocating the key cones provided no change in vehicle path or 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.
• 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
No lock to lock turns

If you have a set of slalomed gates placed 45' apart, the resulting turning radius is approximately 45'.

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

To avoid 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**

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

**better**
- Open up the entering maneuvers
- **Allow plenty of setup room** to enter a 180° turn. Align your entry/exit gate centered to the 180 cone, unless you have allowed extra of room for your entry/exit of the 180 turn.

**entering maneuvers**  "set up" area
The problem associated with narrow walled in turns is that the placement of the wall forces the turn to be made up of 2 or more painful turns instead of a flowing turn. Avoid "Painful" Walled in Turns.
Line of Sight and Gate Positioning

**10 Basic Concepts - Make the Course Flow**

**Bad**

*Driver’s View*

The next gate cannot be seen without turning to look for it

**Poor Solution**

**Better**

*Driver’s View*

this gate is now in peripheral vision

**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 2nd generation Rx7T would have no advantage over a Camaro SS, which in 2004 were found in the same class (BS)
  • 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:

<table>
<thead>
<tr>
<th>horsepower</th>
<th>handling</th>
</tr>
</thead>
<tbody>
<tr>
<td>straights (duh...)</td>
<td>short to medium spaced slaloms</td>
</tr>
<tr>
<td>large radius sweeping turns</td>
<td>small radius sweeping turns</td>
</tr>
<tr>
<td>sharp turns (90 degree or more)</td>
<td>chicane/lane changes</td>
</tr>
<tr>
<td>maneuvers connected with straights</td>
<td>successive maneuvers</td>
</tr>
<tr>
<td>open maneuvers</td>
<td>tight maneuvers</td>
</tr>
<tr>
<td>etc.</td>
<td>etc.</td>
</tr>
</tbody>
</table>

• A straight is any area where full acceleration can be utilized, and is not necessarily 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 (usually near the apex) - use them sparingly
    • Your car will always turn around a pointer when you negotiate the course if it is placed correctly
    • Do not use "Hey-Look At Me" (HLAM) cones - pointers on both sides of a gate
      • These can be confused with a down cone that a worker has not noticed
      • HLAM cones can make an experienced driver turn the wrong way since pointer cones are supposed to be on the inside of a turn

• Directionals
  • A series of lay down cones (3 or more) to guide the driver's to the left or right
    • Effective use of these is to choose a set number of cones (such as 3) and always use that amount when placing them on the course
    • This creates a recognizable pattern anytime a driver sees 3 lay down cones, telling them that it is a directional set and not some cones the course workers missed while telling a good joke

With pointers and directionals, “less is more”
Correct Use of Directionals and Pointers Cones

**10 Basic Concepts - those damn pointers...**

**Problem:** Designer needs to draw attention to these gates

Use of the dreaded "Hey Look At Me" (HLAM) Cones

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

Problem: Designer needs to draw attention to these gates
8.) Line the Course

• Line the course **whenever possible** because it makes it much easier for the inexperienced driver to make it through the course without a DNF.

• The course should NOT be **line dependent**
  • The course must be able to be negotiated successfully if the **lines are “rained” away**.
  • This is accomplished by paying close attention to **basic concept #5**.

• The lining of the course is intended to be a **visual aid** in basic course negotiation and 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**
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.
• 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

<table>
<thead>
<tr>
<th>Direction of travel</th>
</tr>
</thead>
</table>

Perspective View

<table>
<thead>
<tr>
<th>Direction of travel</th>
</tr>
</thead>
</table>
• This is an example of proper use of gates and pointers. The pathway is quite clear and easy to follow.
• 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.
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.
More Examples of “Cone Hell”

Other examples that demonstrate the importance of gate spacing

**Sweeper**

- Confusing
- **Try this**
- Or this

**Lane Change**

- Confusing
- Better

Many course designers have a tendency to use too many cones. 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 your gate width used.
Intended Pathway

could be confusing

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

try this

don't try this

or this
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
    • Whatever 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 Solo2’s)
  • Make your design changes based on the inputs received from your walk through by the Safety Steward, experienced course designer and your drive through

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???)*

- This section contains a method to use that 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
Scale Map of the Topeka North Course Area

- Spectator Area
- Grid Entrance Exit
- North Grid
- Surface Problem Area
- 25' Cement Squares
- Manhole
- Drainage Grates (low area)
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

Start Area

North Grid

200’ Finish Area
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
So You Have a Blank Piece of Paper

Finalized Design Example

See next page to view this section
Section from Finalized Design

So You Have a Blank Piece of Paper

- Chalk Lines
- Cones
- 25' Cement Squares
- Timing Light Line Indication
• 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
Elements of a Bezier Curve

- Bezier Intersection
- Bezier Handle
- Estimated width and path of car
- Cone

What **NOT** to do

- Handles not similar in length
- Handles overlap
### Cornering Speeds in MPH

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- 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
# Course Design and Event Setup

## Acceleration and Braking Distances in Feet

### Acceleration distances

- **Based on A quick SP car**, which could do 0 - 60 mph in 4.1 secs

### Braking distances

- **Based on constant 0.8 g braking** (typical published vehicle maximum braking effort on street tires)

- This half of the chart can be used to estimate braking distances of lower performance cars and for estimating stop box length

### Be sure to add plenty of margin to the actual stop box so that all cars can easily stop within the box

- In addition, when raining, these stop distances increase considerably (**about double**)

### Determine speed up to, and braking points before a turn

- If you have **150 foot straight** which you enter from a **35 mph turn**, and which concludes with a **40 mph turn**, a well driven car will attain a speed of **about 60 mph**

### Table: Starting Speed vs Target Speed

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Slalom Speeds in MPH

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- 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
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.
So You Have a Blank Piece of Paper

Pits
(between course and road)

Finish

The Houston Region SCCA Proudly Presents:

Texas Seagull Target Practice

Day 1

designed by Roger Johnson

Dog Track Facility
The Houston Region SCCA Proudly Presents:

Larry's Disturbing Vision

Regional Event #1

Designed by Roger Johnson

Car # ____________
Class ____________
Run Heat __________
Work Heat __________
So You Have a Blank Piece of Paper

Seagull Target Practice
Precision Racing Org Championship Series
Event #3
LaMarque, TX
181’ R turn followed by 100’ straight

What's Wrong With this Finish?
• 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...

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

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• Every change you make - will impact somewhere else
• Every competitor, skill and common sense level are different
• Every lot has different shapes, hazards, restrictions, overall grip
• Humans can be totally unpredictable
  • So plan your 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
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**
  • Can **impair** the **driver’s judgment** when to safely stop
    • Can result in going **through the end of the finish**
  • **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**
  • The **higher** the **hazard**; the **higher** the approach **speed** = the **more run-out allowed**
  • 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)
  • If the exit is aimed towards **pesky humans** add an additional **75’ buffer** (min)
    • Long enough to allow stopping with **brakes locked** (not the best way to stop)
    • **Ample buffer** after the end of the finish lane (>75’ of people or objects)
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
  • Make sure the "slowing turn" intended 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
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)

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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
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Large, Expansive Sites

DAY 1
Fort Worth National Tour
SCCA Solo 2 Event
1999
So You Have a Blank Piece of Paper

Large, Expansive Sites
(continued)

Differences between Day1 and 2 besides course direction
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^)
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Narrow Road Course Sites

The Houston Region SCCA presents
Libidinous Asphalt Gluttony
otherwise known as:
Primitive Biological Urge to
Consume Mass Quantities of Asphalt
Southwest Divisional Series
Event #2
July 10/11, 1999
from the twisted mind of:
Roger Johnson

Diagram of the road course with work stations labeled:
- Work Station 1
- Work Station 2
- Work Station 3
- Work Station 4
- Work Station 5

Car Number
Class
Work Heat
Run Heat

Day 1
Differences between Day 1 and 2.
Note that course direction is same both days.
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Other Difficult Shaped Sites
Agenda

• Fundamentals

• 10 Basic Concepts

• So you have a Blank Piece of Paper...

• Elements, Dimensions and Real Speed

• Summary and Questions
• 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” (TW) 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

• 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
The relationship of the radius of the turn and the cornering G’s is shown in the table below:

<table>
<thead>
<tr>
<th>G Force</th>
<th>Radius 50'</th>
<th>Radius 75'</th>
<th>Radius 100'</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.90</td>
<td>25.9</td>
<td>31.7</td>
<td>36.6</td>
</tr>
<tr>
<td>0.85</td>
<td>25.1</td>
<td>30.8</td>
<td>35.6</td>
</tr>
<tr>
<td><strong>0.84</strong></td>
<td><strong>25.0</strong></td>
<td><strong>30.6</strong></td>
<td><strong>35.3</strong></td>
</tr>
<tr>
<td>('93 Camaro)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>0.82</strong></td>
<td><strong>24.7</strong></td>
<td><strong>30.2</strong></td>
<td><strong>34.9</strong></td>
</tr>
<tr>
<td>('93 Sentra)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.80</td>
<td>24.4</td>
<td>29.9</td>
<td>34.5</td>
</tr>
</tbody>
</table>
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.)

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
Tuning circle: 39.0
Brakes
Front, type/dia., in: Vented discs/10.9
Rear, type/dia., in: Vented discs/11.4
Tires: (Standard)

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 mph: 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:
30: 30
40: 40
50: 50
60: 60
Interior noise, dBA:
Idling in neutral: 62
Steady 60 mph in top gear: 75
Under full acceleration from 30 to 70mph, the Camaro will travel 426.25 feet in 5.5 seconds
Under full acceleration from 30 to 70 mph, the Sentra will travel 627.75 feet in 8.1 seconds.
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 much effect can a big straight have on the competition?
  • Compare the transit times already known
    • Camaro:
      • 30 - 70 in 5.5 seconds; 426 feet
    • Sentra:
      • 30 - 70 in 8.1 seconds; 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 power
  - O.K. - The Camaro (F Stock) is not classed with the Sentra (G Stock) but classes in Solo do contain mixtures of cars! For example:
    - (In 2004) B Stock:
      - 2nd Generation Rx7 Turbo
        - 2,850 pounds / 182 horsepower = 15.66 lbs/hp
          (where a bigger number = slower acceleration)
      - 2002 Camaro SS
        - 3,600 pounds (pig...) / 345 horsepower (oh my…) = 10.43 lbs/hp
    - That is a 52% difference 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
  - Camaro
    - 3,373 pounds / 275 horsepower = 12.30 lbs/hp
    - That is a 51% difference between the cars in our example

The horsepower to weight ratio disparity in our example is approximately the same as the B Stock Rx7T and the Camaro SS, thus illustrating the need for a balance of Power and Handling maneuvers in Solo2 course design.
Speed in Solo2 Course Design

• How fast do we go?

• Why do we care?

this could be information
*some of you*
don’t want to know...
What the Rules Say

• “...should not normally exceed the low 60’s (mph) for the fastest Stock and Street Prepared 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 Stock or SP 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 *(horror*) 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 (e.g. Solo 1, Solo Trials)

• 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?

• 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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        rogerthereal@entouch.net

• Website
  • http://home.entouch.net/rogerthereal

• Complete Course Design Booklet
  • http://houscca.com/solo/courses/Course_Design_4-1-2.pdf