SAE DETROIT SECTION

FSAE Workshop 2011

Fundamentals for FSAE Design

Design Considerations

October 22, 2011

Design Considerations

- General Design Process
- Important Considerations
- Qualitative "Rules"
- Things to Ask During All Project Phases
- Design Trends
- Q & A

General Design Process

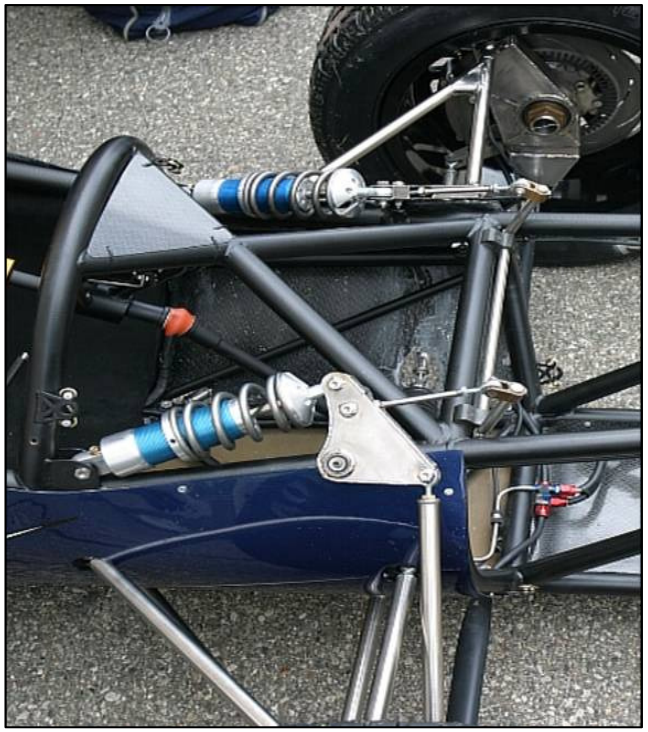
- Starting point? -Rules, Tires, Scores, Lessons Learned…
- On a per event basis, what are your goals?
- What performance specs will meet those goals?
- Break car into systems and work down
- Big picture overrides all else
- Complete vehicle lay-out (mass & CG of every bit)
- Synthesis- every component, it's interactions
- Weight distribution and CG are more than a spec
- Iterate through systems integration issues

Important Considerations

- K.I.S.S. vs. High Tech
- Tire Data – FSAE Tire Test Consortium
- Data Acquisition – engineering and driver tool
- Mass vs. Stiffness - A balancing act
- Fuel? E85, or fossil fuel
- Itty bitty parts – mass vs. reliability
- Materials – carbon=cool, but is it the right choice?
- Modeling and analysis vs. physical testing

Design Complexity

Both do the same job…

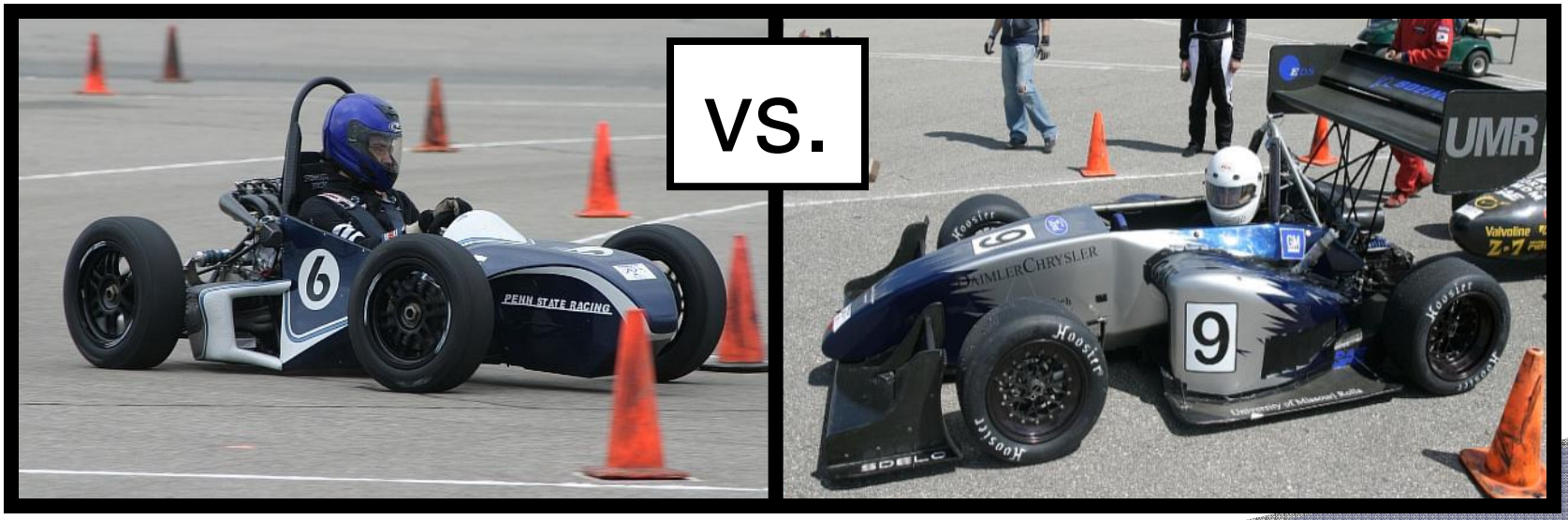


What are the performance gains vs. cost, effort, and mass trade-offs?

Aerodynamics

You must consider:

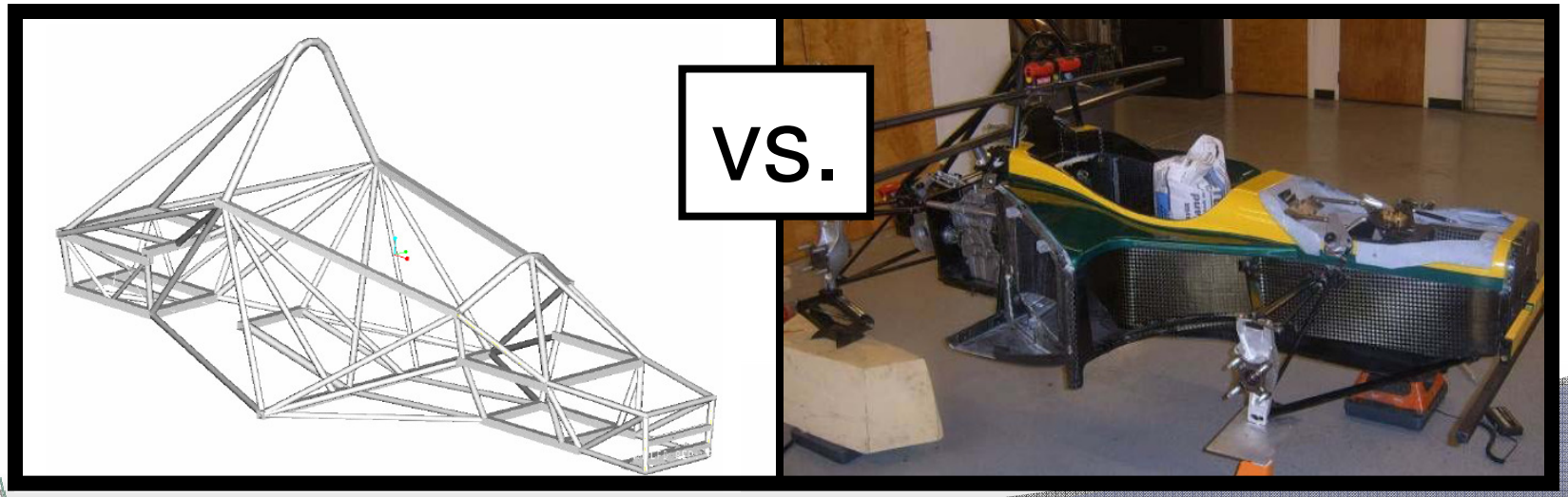
- Time and expense to design and build vs. REAL benefits
- development time
- mass effects
- actual competition benefits (stopwatch and judges)



Composites

You must consider:

- Time and expense to design and build vs. REAL benefits
- Analysis capability, can you predict your performance?
- Development time
- Cost & mass effects
- Composites are ***very*** process sensitive, allow time to build it twice
- When problems are found in tech, what is plan B?



Qualitative Design "Rules" to keep in mind

- Good design → If it looks right it usually is
  - Corollary → If it looks wrong, well…
- Good load paths are your friend
  - Triangles (really tetrahedrons) = good load paths
- The part not on the car has zero mass, no cost and can't fail
  - The reward in performance must outweigh the risk and penalty
- Systems Engineering → Know it, Love it, Live it
- Engines → Spark it right, always. It's the biggest knob you have for engine performance.
- Mass → ***Mass begets mass***. There is no minimum weight.
  - Make it ***light***. But don't break.

Things to Ask During All Project Phases

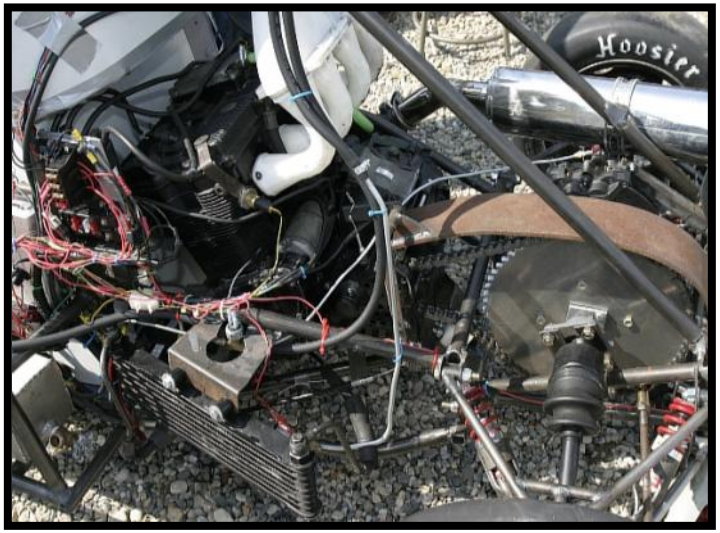
- Does the car look like it was designed with a systems focus?
- What parts look like after thoughts? Were they?
- Is packaging tidy and look planned?
- Are items such as wiring exposed or neatly routed in looms?
- Are components adequately protected from environment
  - brake lines on the front or rear surface of A-arms?
  - wires crossing over hard sharp edges?
- Is the car reasonable to maintain and adjust?
- Is the car on track to mass, CG and packaging expectations? Why?
- Tuning? Can discrete adjustments be made?

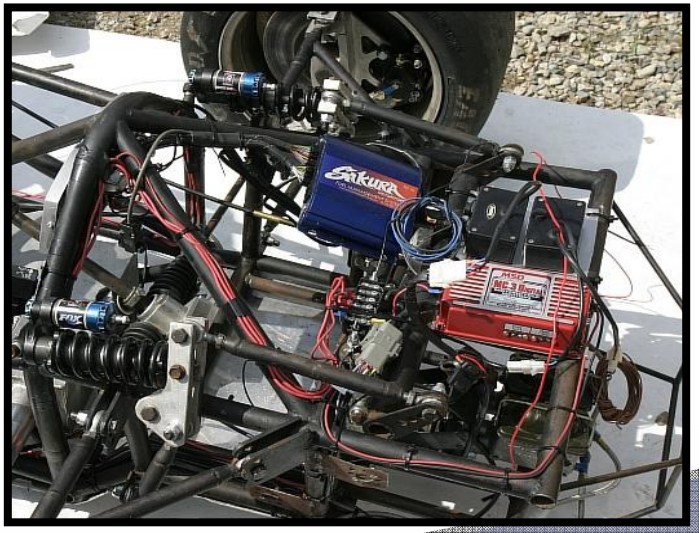
Packaging Examples

Not clean,

Not well thought out,

and asking for trouble!





Packaging Examples

Well thought out,

Well integrated, and

Few surprises.

This is where the

Upfront work pays off!!

Questions ?

Anthony Lyscio
anthony.lyscio@gm.com