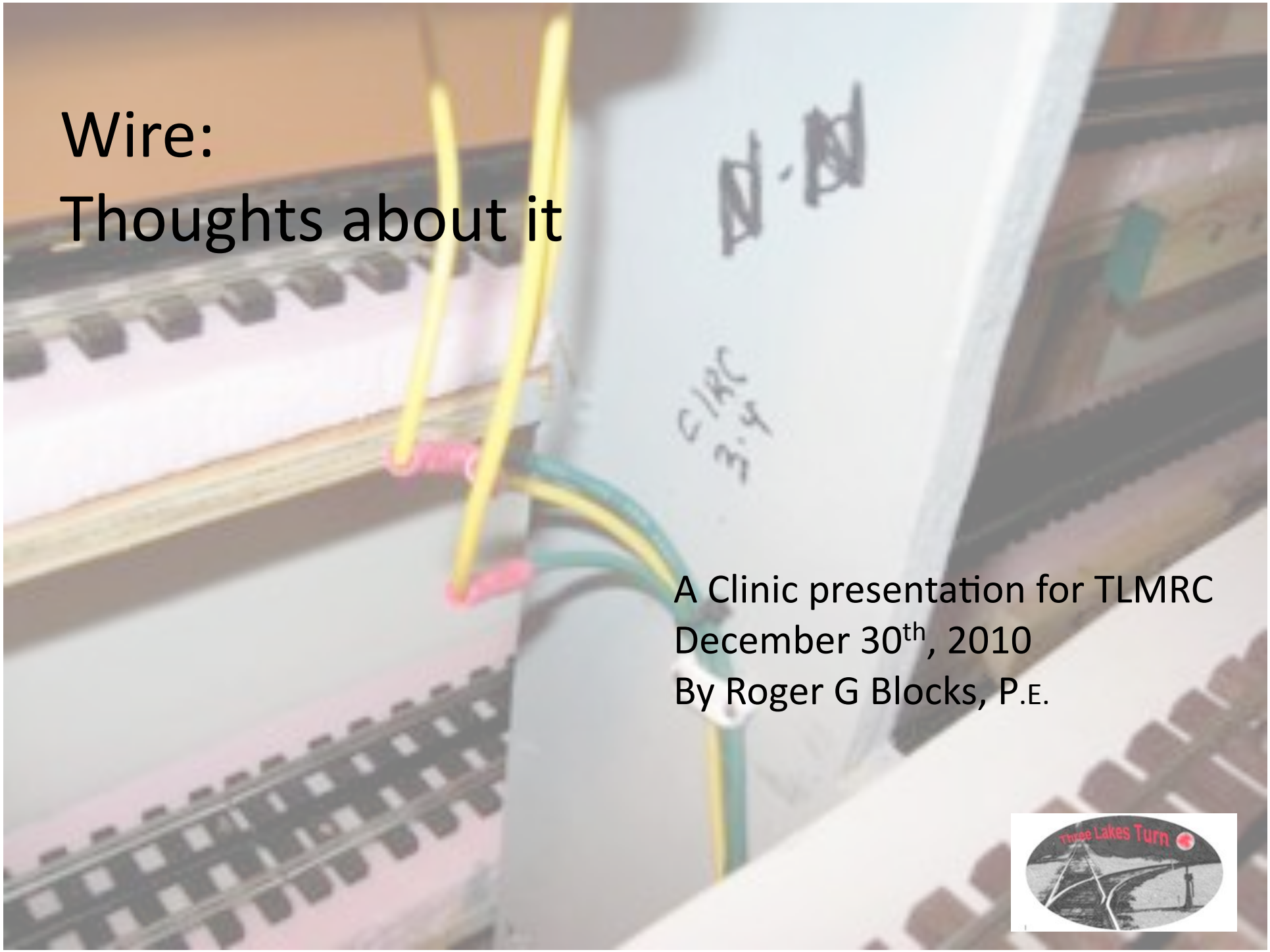
Wire:
Thoughts about it



A Clinic presentation for TLMRC
December 30th, 2010
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Basic Ground-rules

- NEC – National Electrical Code specifies wire
- We'll simply cover some rules of thumb
- Ours will be an overview: see NEC for details
- I'm not telling you what to do or use
- Be smart: do it right the first time (costs less)
- Read, plan, consult, design, review, build

Wire Capacity

- Wire choice: Al vs. Cu vs. Clad
- It is all about heat
- You don’t want to overheat insulation
- You don’t want to melt the wire
- You don’t want to start a fire
- Cu is the most affordable & easy to solder

Copper is it.. For now

- Copper is the only choice for your wire
- Insulation of used wire is unknown…use new
- 75 degree C (167 F as one max limit)
- 75 degree C will produce 3rd Degree skin burn
- Obviously way too hot…
- If you feel heat in your wire.. Go up a gauge
- Better: use a reliable meter and a little math

Electrical Computations

- $V = I \times R$: volts = amps times resistance
- $R = V / I$: resistance = volts divided by amps
- $I = V / R$: amps = volts divided by resistance

- $P = V \times I$: watts = volts times amps
- $P = V^2 \times R$: watts = volts squared x resistance

see next slide for all of the combinations..

NEC for Homes

- 14 AWG = 15 Amp max
- 12 AWG = 20 Amp max
- 10 AWG = 30 Amp max
- Note these are the max that you should expect out of wire…
- Most homes are using switching power supplies in TV's, Microwaves, Amplifiers in Sound systems… and the neutral is warm !

Wire is a resistor

Wire Gauge	Max Amps in Air Unconfined Wire	Max Amps for Confined wire
• 24 Ga	3.5 Amps	• 2.1 Amps
• 22	7.0	• 5.0
• 20	11.0	• 7.5
• 18	16.0	• 10.0
• 16	22.0	• 13.0
• 14	32.0	• 17.0
• 12	41.0	• 23.0
• 10	55.0	• 33.0

How many ZW's?

- Start with a 15 Amp circuit.. 14 ga. @120 vac
- P = V x I or 275 watts
- I = 275 / 120 = 2.3 Amps
- Thus, 15 / 2.3 = 6.5 or   6 ZWs is the limit.
- Crazy? You bet…

6 ZW's ?

- Hey is that safe???
- Sure if household wires are not kinked
- Perhaps one in ten is kinked
- So what's the limit…? I use about 2/3rds max
- Thus, it's not 6 ZW's but 4 ZW's max by my rules…

De rated wire

- Resistance goes up with temperature
- Use the 60 C or 140 F tables rather than cold wire tables at 20 C or 68F for safety.
- Be conservative as in the following table

Ohms / Foot : Long Runs

- 24 AWG = 3.12 Ohm / 100 ft
- 22 = 1.96
- 20 = 1.23
- 18 = 0.776
- 16 = 0.488
- 14 = 0.307
- 12 = 0.193 (these are all de-rated ~3% for safety. RGB)

Voltage Drop.. Thick wire

- An HO engine draws about 1 amp give or take
- Lets' start with track being 50 feet from the transformer and figure the drop with 12 ga
- Two wires x 50 ft = 100 ft… like in the table
- V = I x R = 1.0 Amp x 0.193 Ohm = 0.193 Vdc
- If we apply 6 volts.. Then 6 - .193 = 5.807 vdc
- Or a voltage drop that is about 3.5 % ..

Voltage Drop.. Thin wire

- An HO engine draws about 1 amp give or take
- Lets' start with track being 50 feet from the transformer and figure the drop with 24 ga
- Two wires x 50 ft = 100 ft… like in the table
- V = I x R = 1.0 Amp x Ohm 3.12= 3.12 Vdc
- If we apply 6 volts.. Then 6 – 3.12 = 2.88 vdc
- Or a voltage drop that is about 52 % .. Wow


Go from Here…
Three Lakes Turn