



Patching of Portland Cement Concrete Pavement

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Roadmap of the Presentation

- **Introduction**
- **Challenges of patching projects**
- **Construction and workmanship**
- **Materials considerations**
- **Maturity concept and opening to traffic**
- **Conclusions**



Full-Depth Patching

■ Typical Use

- Restore rideability and structural integrity
- Prevent further deterioration of distressed areas
- Preparation for an overlay

■ Restrictions

- Does not address structural inadequacy
- Not a long-term solution for material-related distresses
- Cost



Quality of Repair

- **Materials**
- **Procedures**
- **Workmanship**
- **Long-term performance (patch survival rates)**
- **Long-term cost effectiveness**



Causes of Patch Failure

- **Poor workmanship**
- **Improper base and subbase preparation**
- **Low opening to traffic strength**
- **Variability of materials**
- **Improper use of materials**
- **Insufficient consolidation**
- **Incompatible thermal expansion**
- **Weathering of material**



Current Challenges in Concrete Patching

- **Lane closure policies for the interstate influence the following:**
 - Traffic control of the work zone
 - Worker safety
 - Equipment mobilization
 - Workmanship of the patches
 - Patching construction in stages
 - Time to open to traffic
 - Longevity of the patches



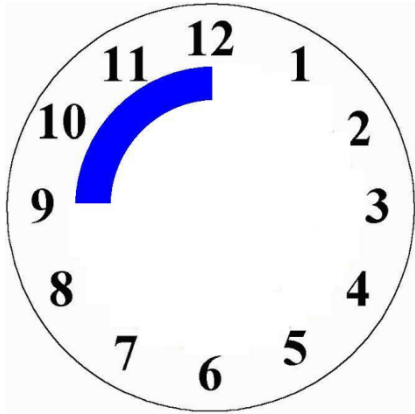
Patching Construction Steps

- **Layout repair locations**
- **Saw concrete**
- **Remove concrete**
- **Prepare area**
- **Provide load transfer**
- **Place and finish concrete**
- **Cure**
- **Seal joints**

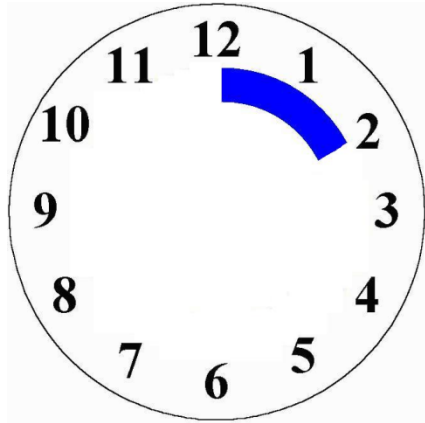




Construction timeline of patching project



Construction timeline of patching project



Construction timeline of patching project



- What is the required strength?
- How to achieve it?

Curing time and open to traffic

Opening to Traffic

- **Manufacturer recommendation**
- **Opening criteria**
 - Minimum strength
 - Minimum time
- **Opening based on actual PCC strength is preferred:**
 - Cylinder or beam testing
 - Concrete maturity



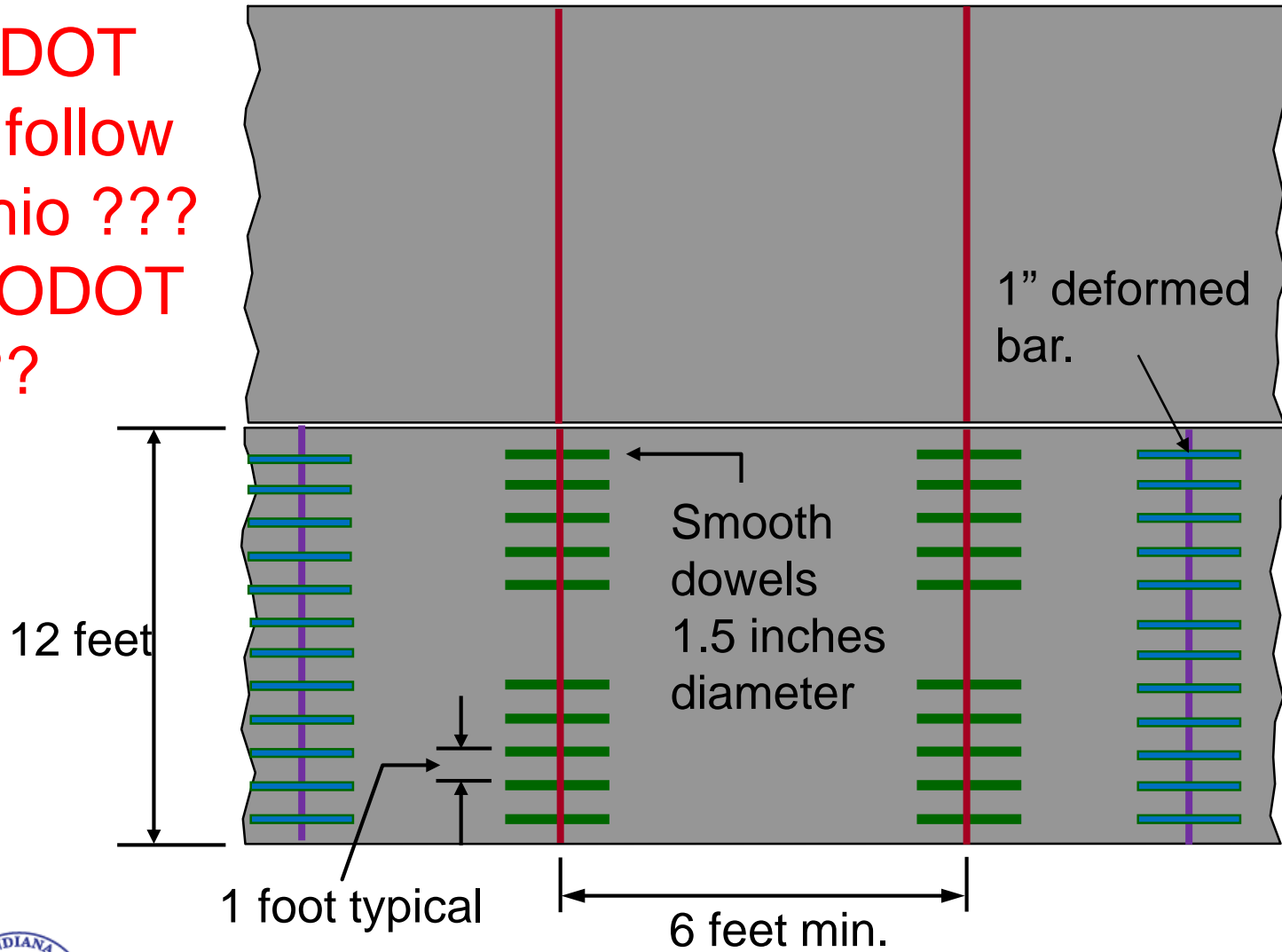
Criteria for Opening to Traffic

- **Compressive strength:**
 - 2,000 psi
- **Modulus of rupture:**
 - 300 psi center-point loading
 - 250 psi third-point loading
- **Minimum time:**
 - Depends on mix, slab thickness, and ambient temperature (INDOT: ambient temperature and ADT)

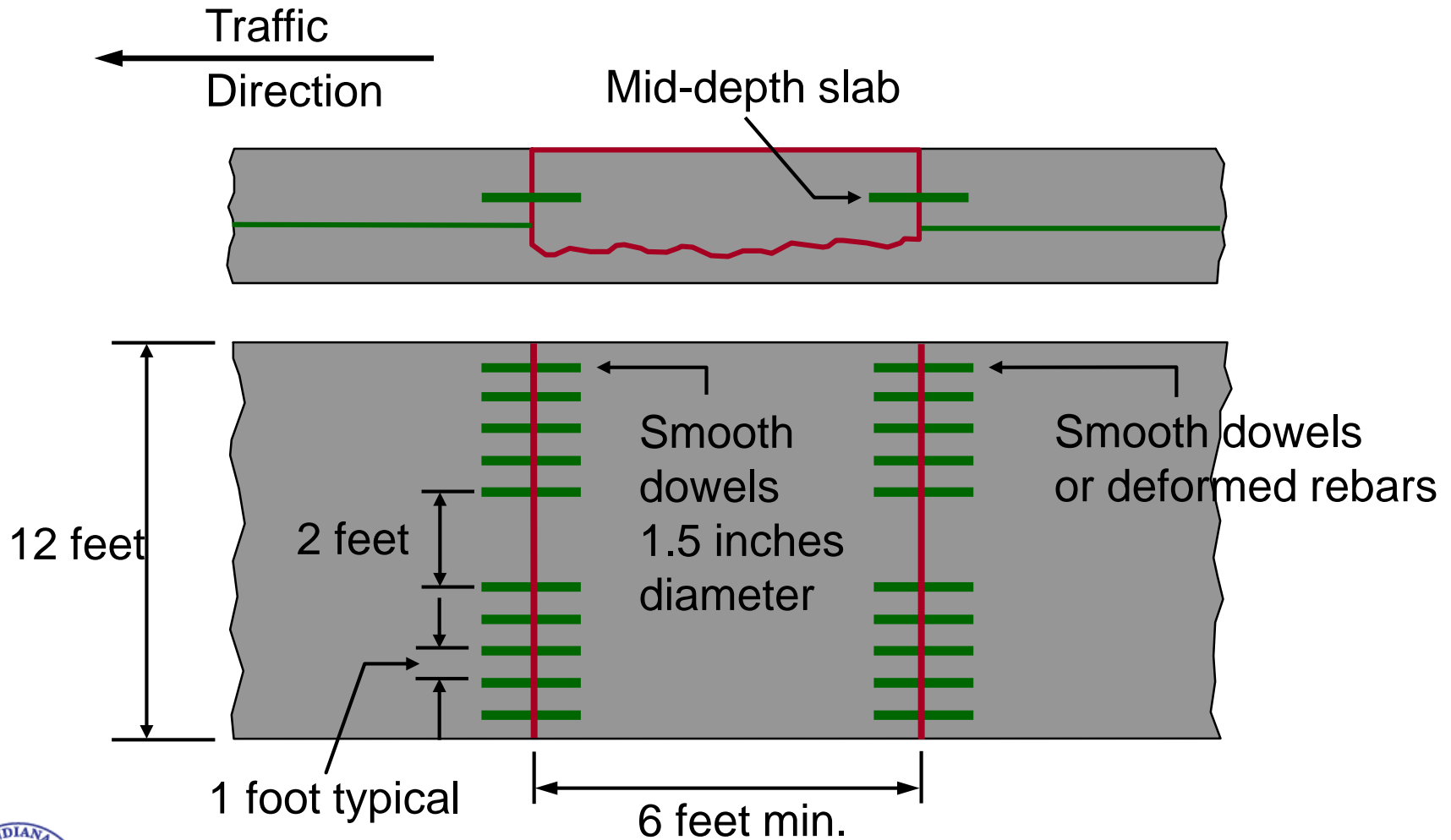


Ties and Joints

INDOT
to follow
Ohio ???
WODOT
???

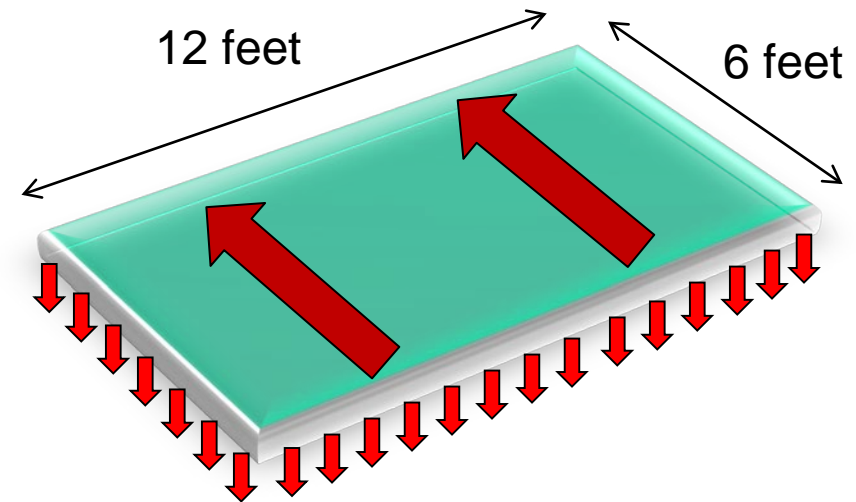


Patch Dimension



Patch Dimension

- Pressure to the soil due to tandem axle
 - $34,000 \text{ lbs}/(12 \times 6 \text{ feet}) = 3.3 \text{ psi}$



4 to 7 psi Allowable stress for soil

Workmanship



Materials Mixing Issues

- Materials
 - Patching materials
- Methods
 - Drum mixers
 - Mobile mixers
 - Mortar mixers
- Mixing
 - Manufacturer recommendation
 - Mixing sequence
 - Amounts
 - Mixing times
 - Water content



INDOT Experience with Maturity

- **Applies to “Long” Patches (> 15 ft in length)**
 - Liquidated Damages for Late OTT
 - Unique Special Provision Implemented 2013
 - HES Concrete using Chemical Admixture System
 - 425 psi Flexural for OTT to meet constraints of job
 - 550 psi in 2-days
 - Trial Batch required



INDOT Experience with Maturity

- **Trial Batch for HES Concrete**
 - Validate Compliance
 - Conduct Maturity
 - Test beams at 4, 8, 12, 24 h, & 2-days or ????
 - Backup for OTT Beams (2 beam average per test)
 - Cautioned used when earlier than 24 hours

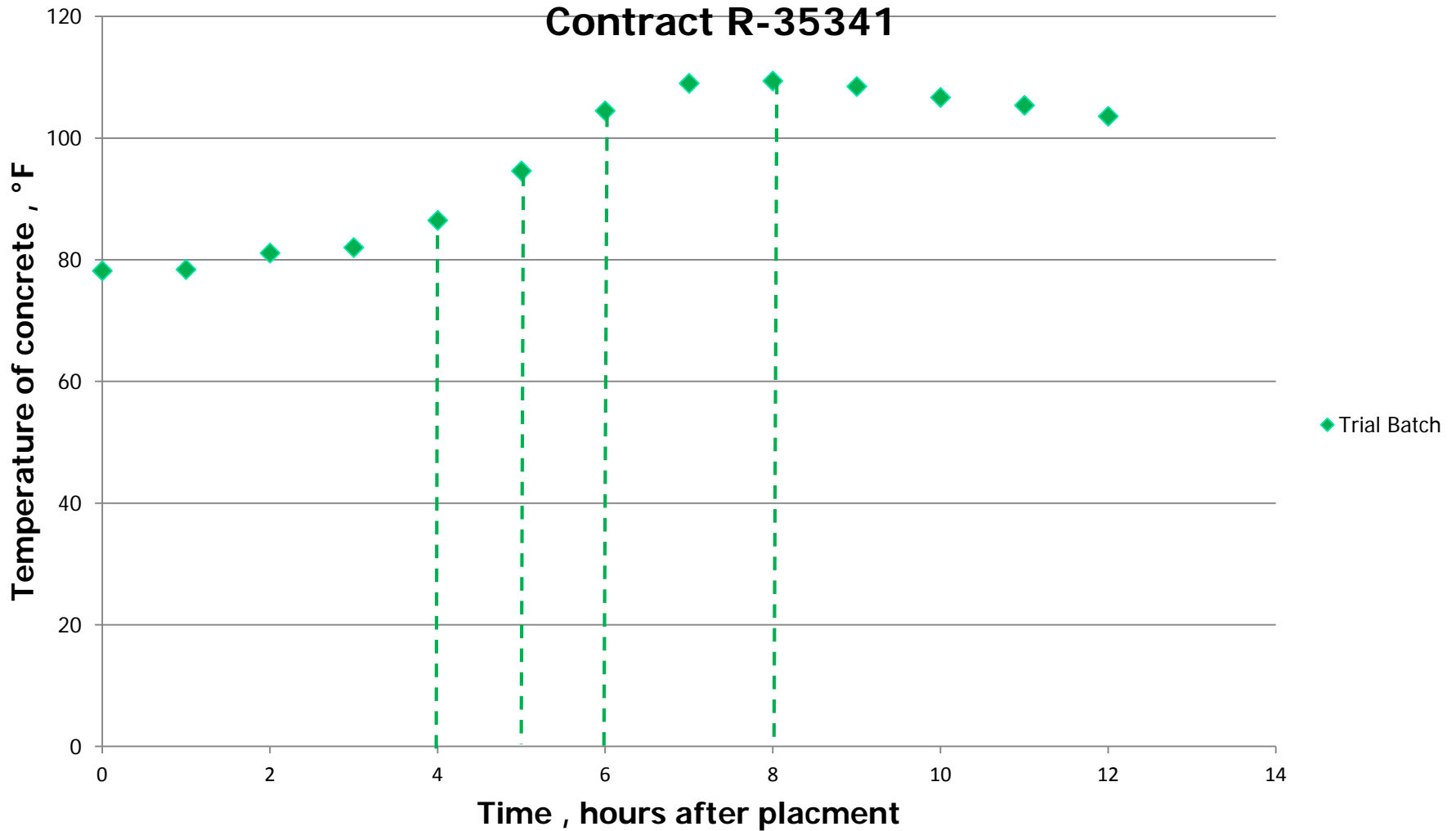


INDOT Experience with Maturity

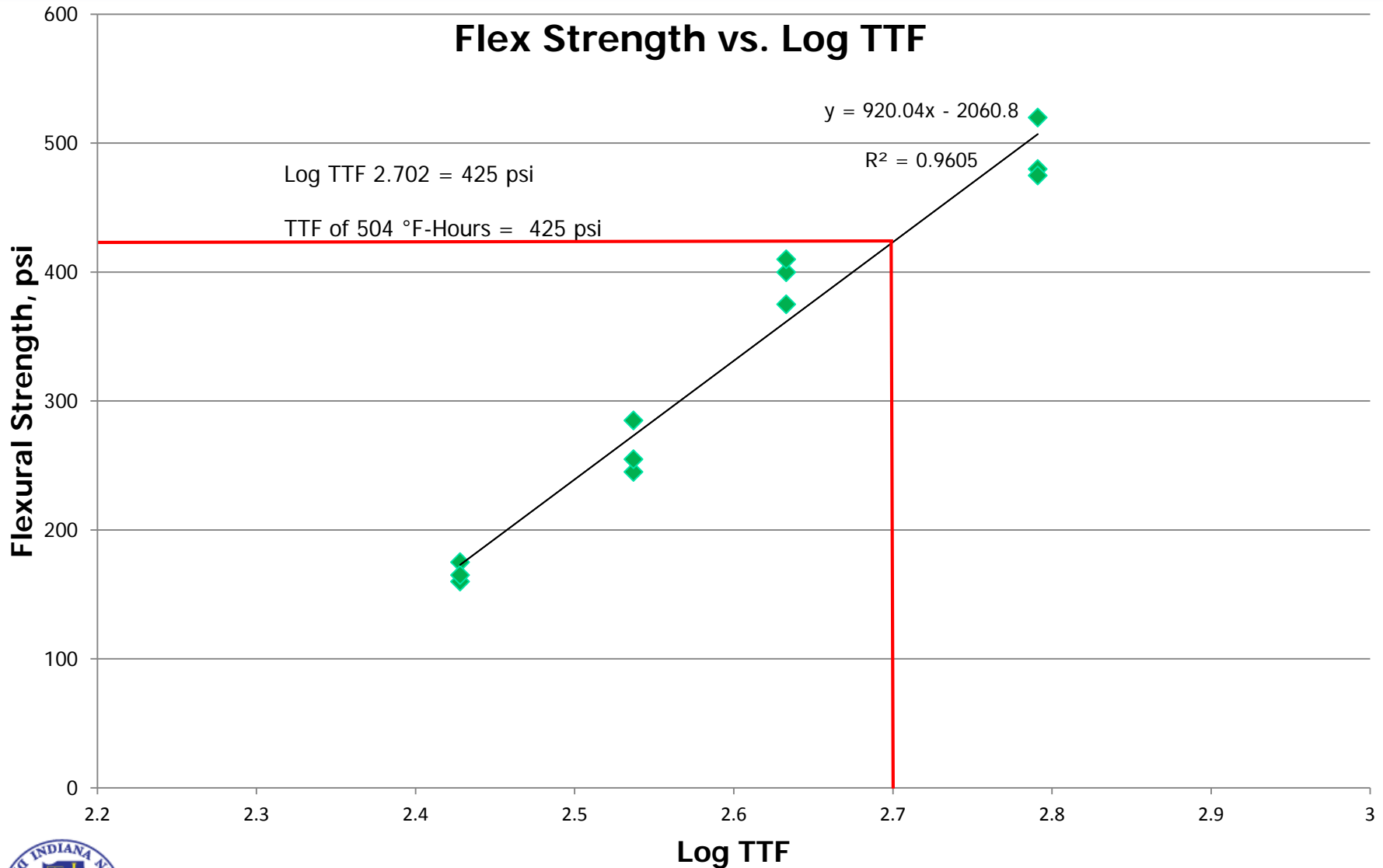
- Nurse-Saul Maturity Function (ITM-402)
- $\Sigma TTF = \Sigma [((T_2 + T_3) / 2) - 14] \times (A_1 - A_2)$
 - TTF = Time Temperature Factor in °F-h
 - A_1 = age in hours, at end of interval
 - A_2 = previous age in hours, beginning of interval
 - T_2 = concrete temperature in °F, at end of interval
 - T_3 = concrete temperature in °F, at beginning of interval



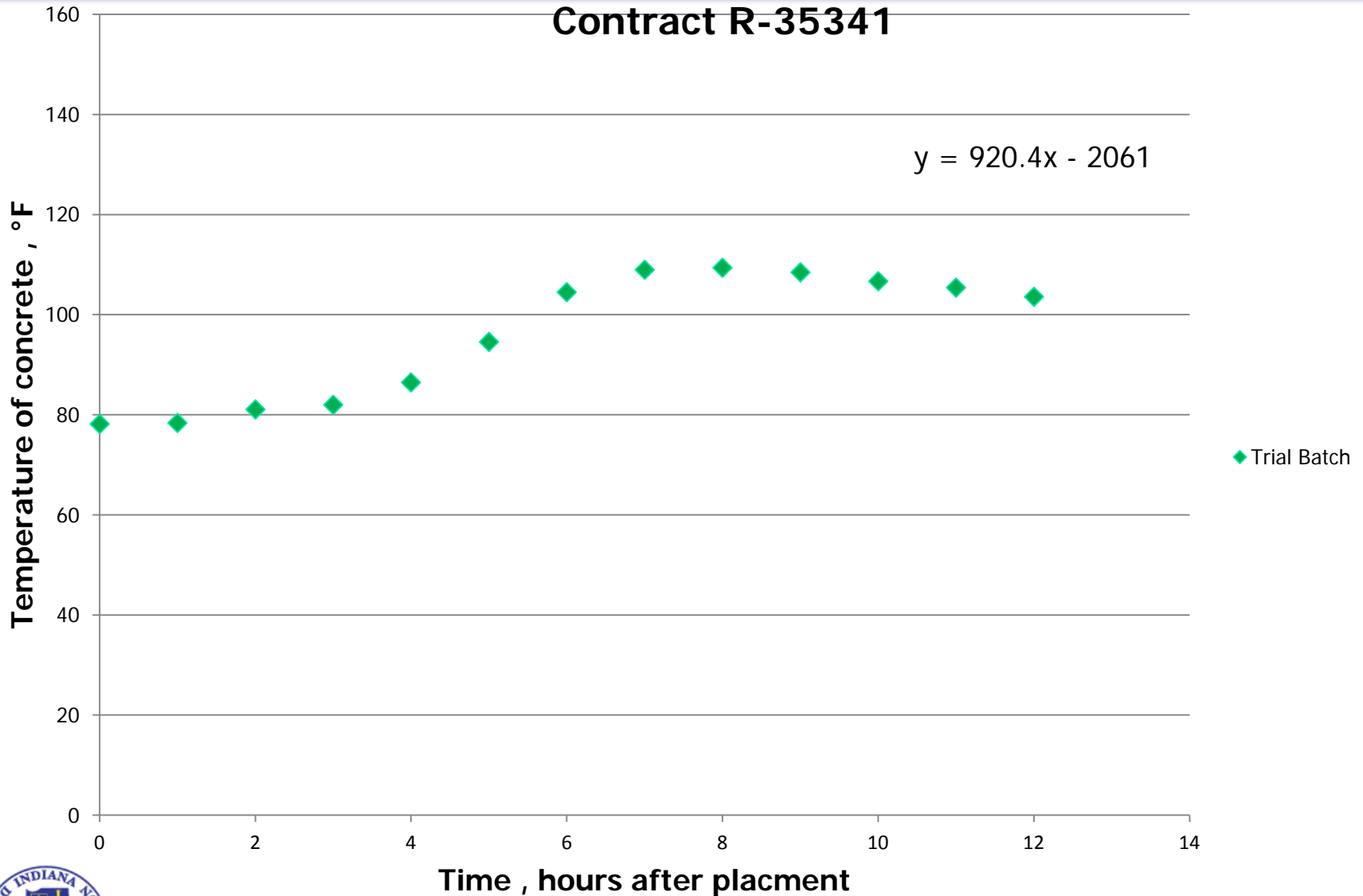
INDOT Experience with Maturity



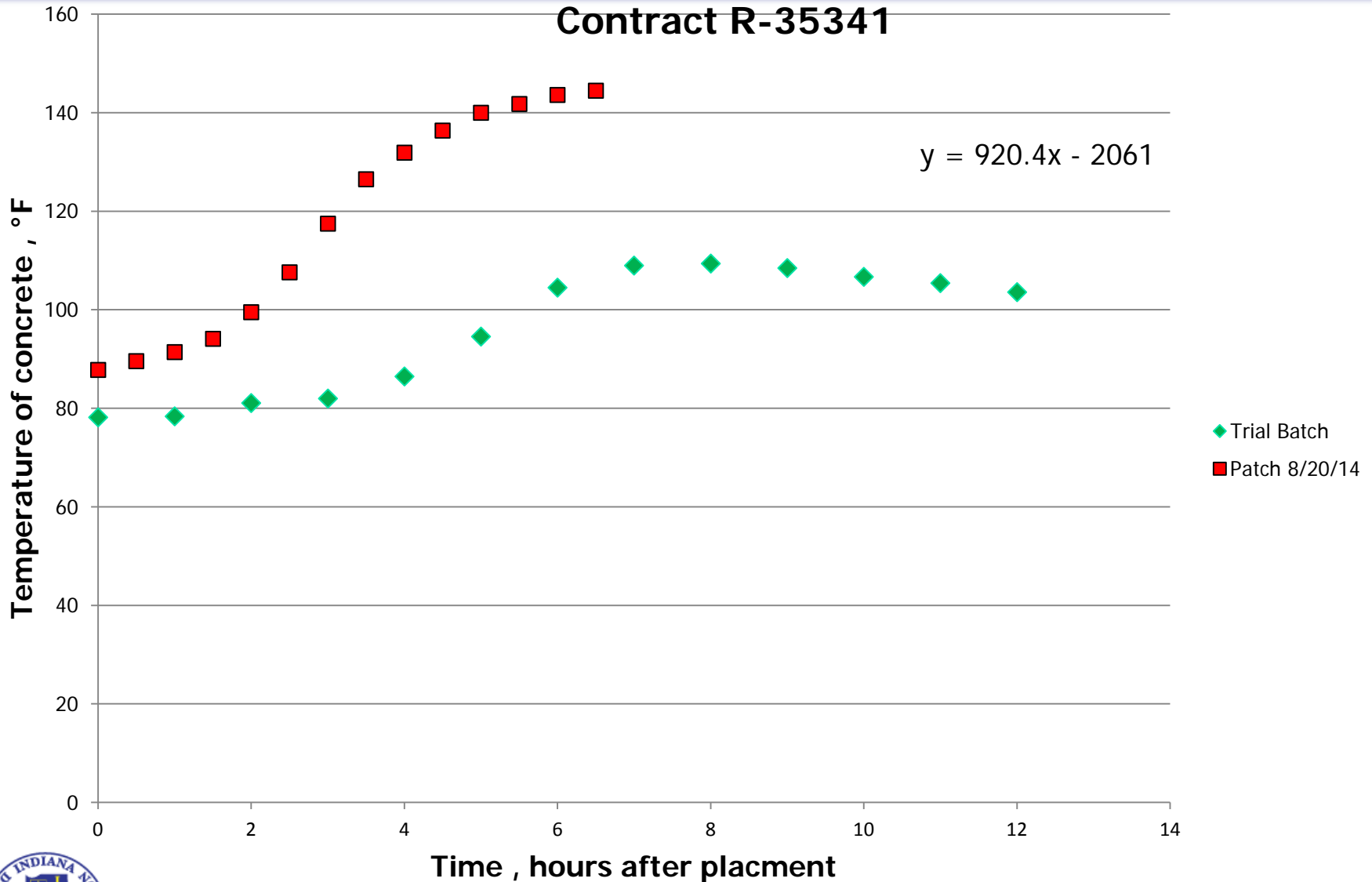
INDOT Experience with Maturity



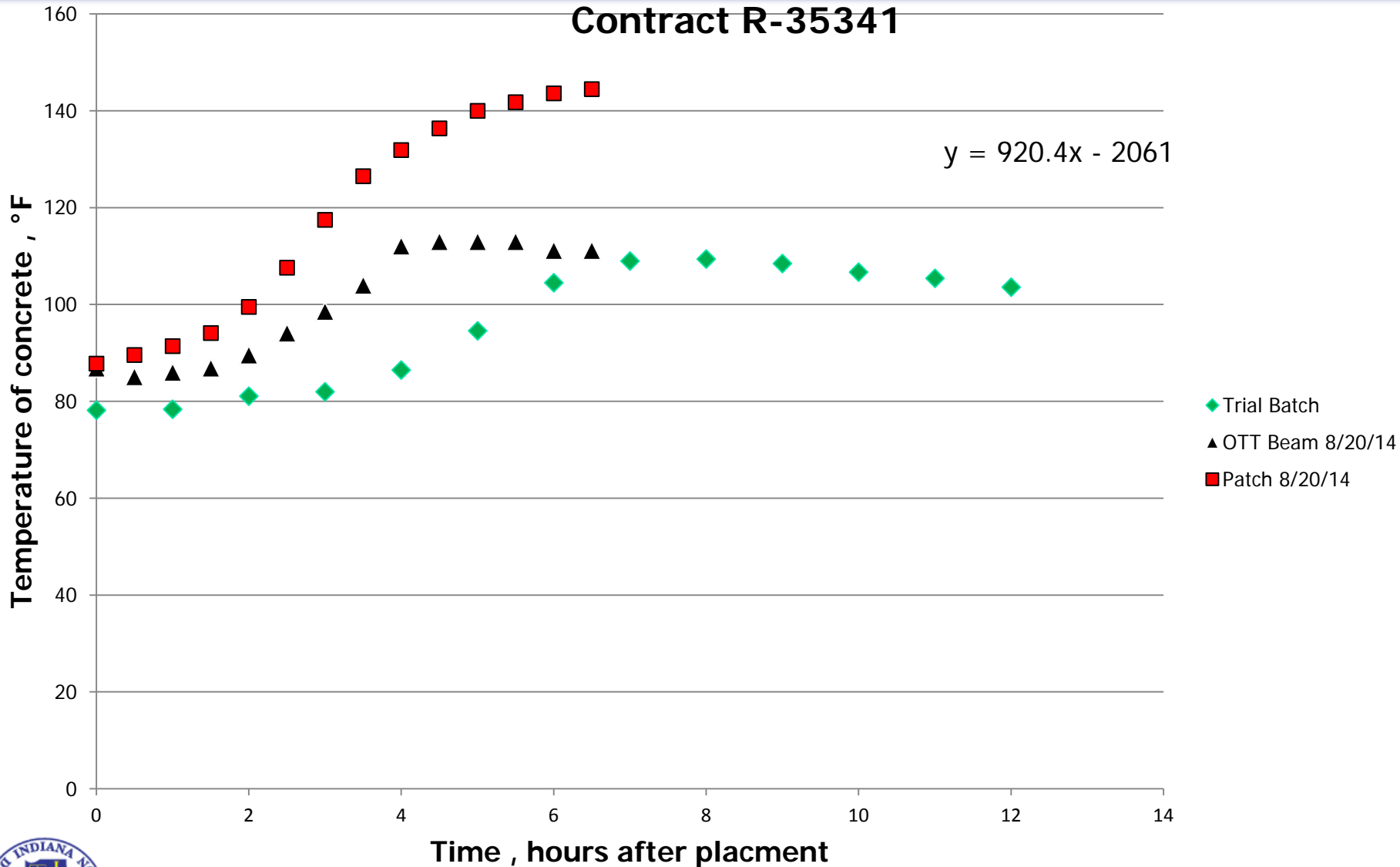
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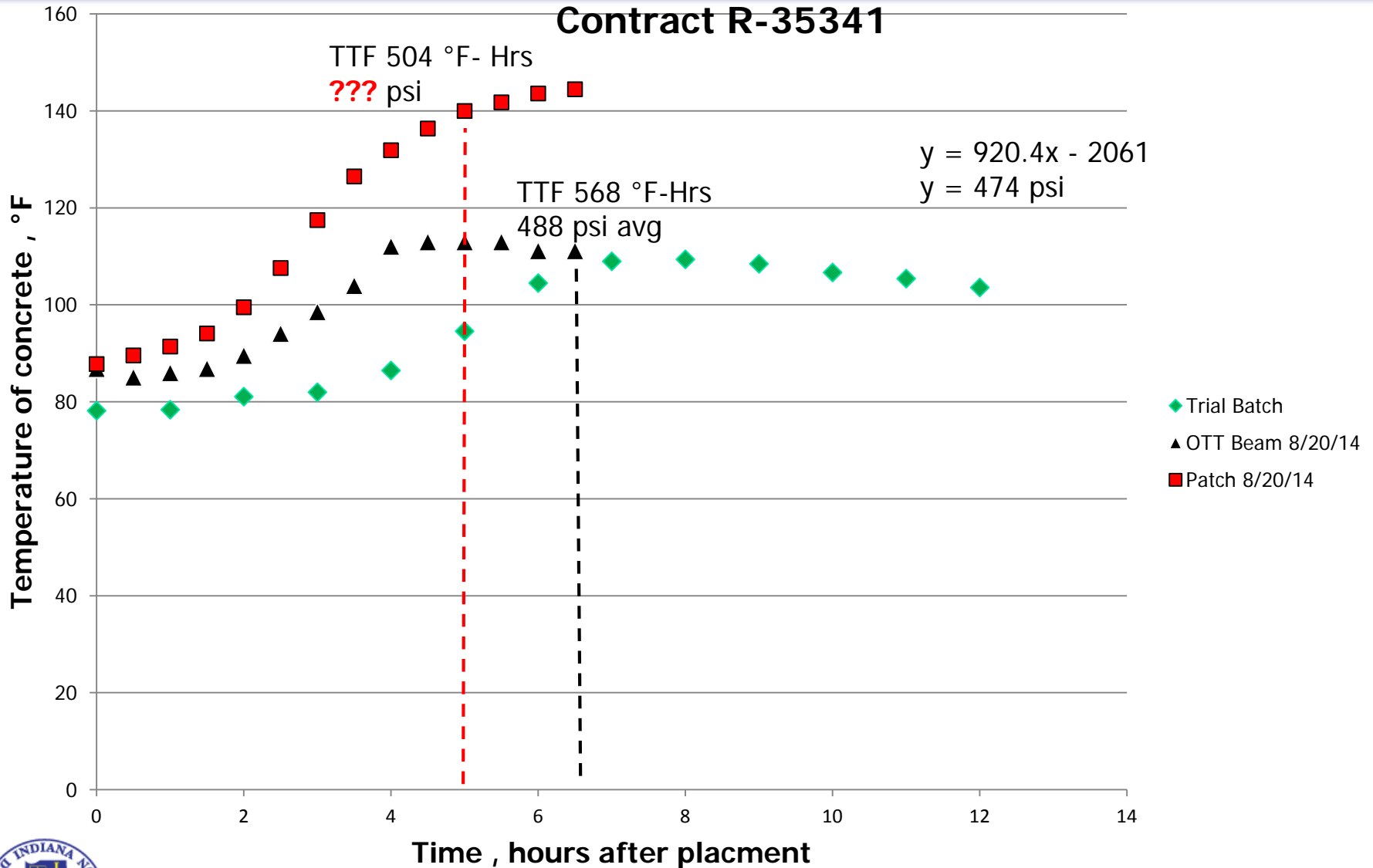
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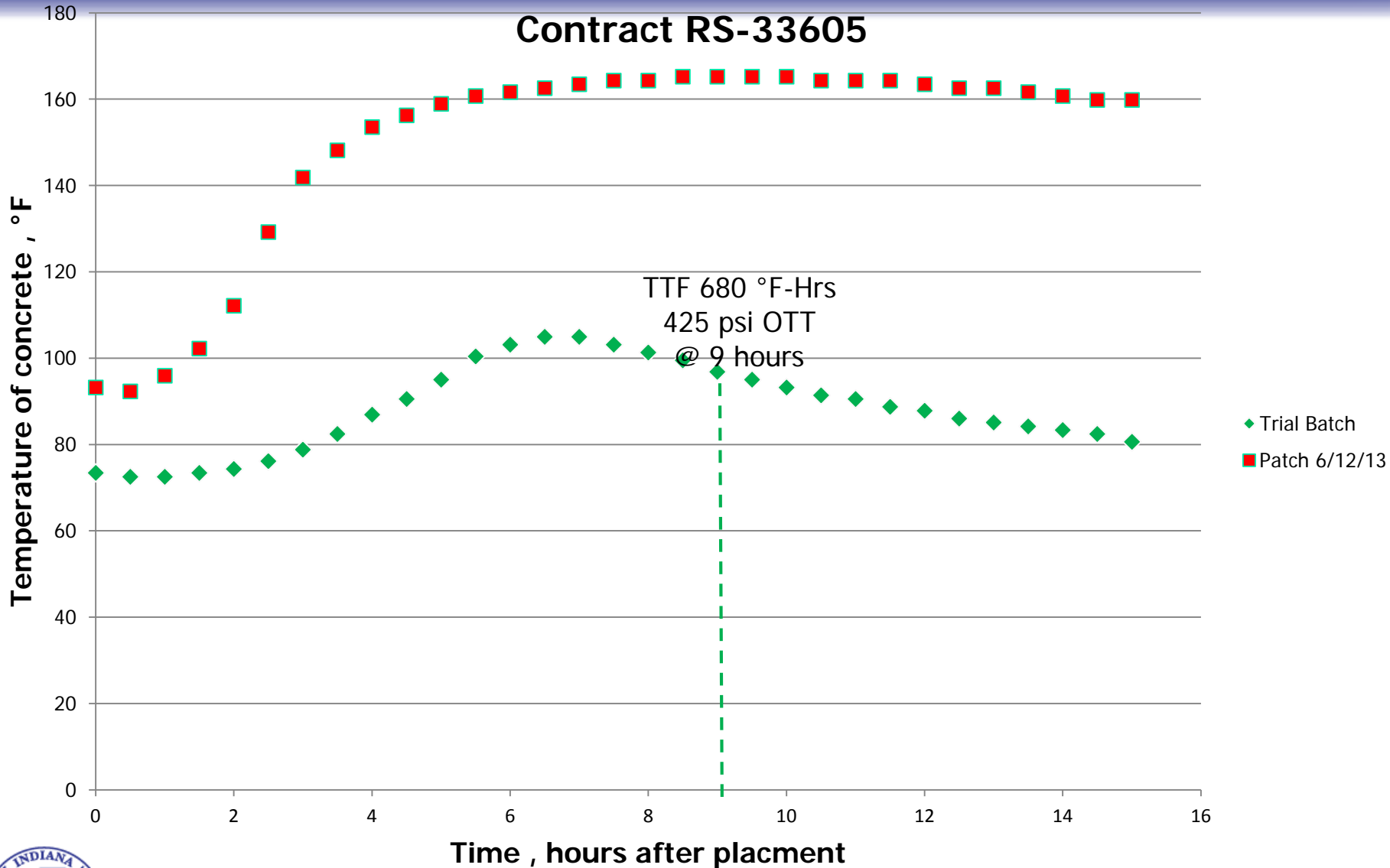
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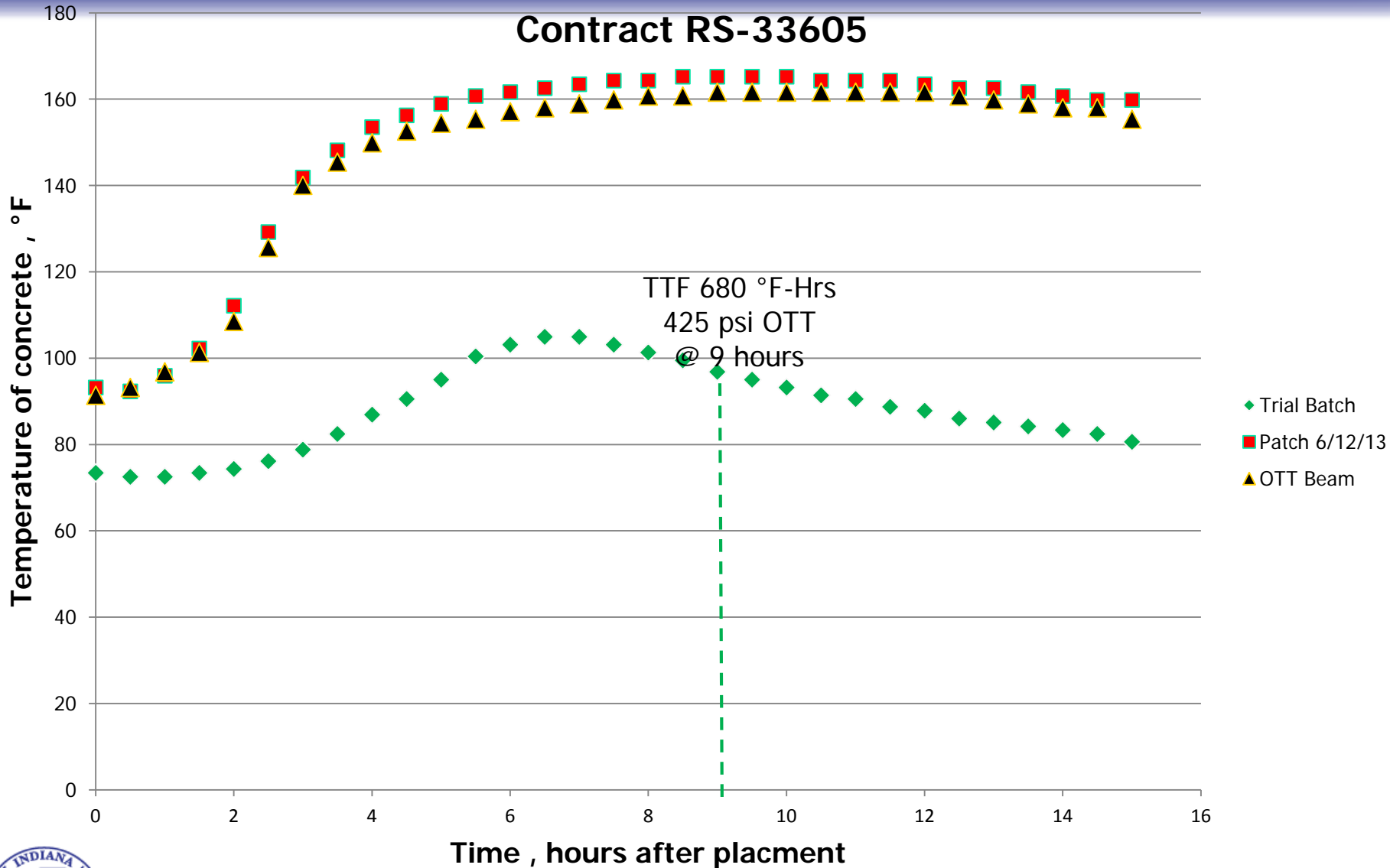
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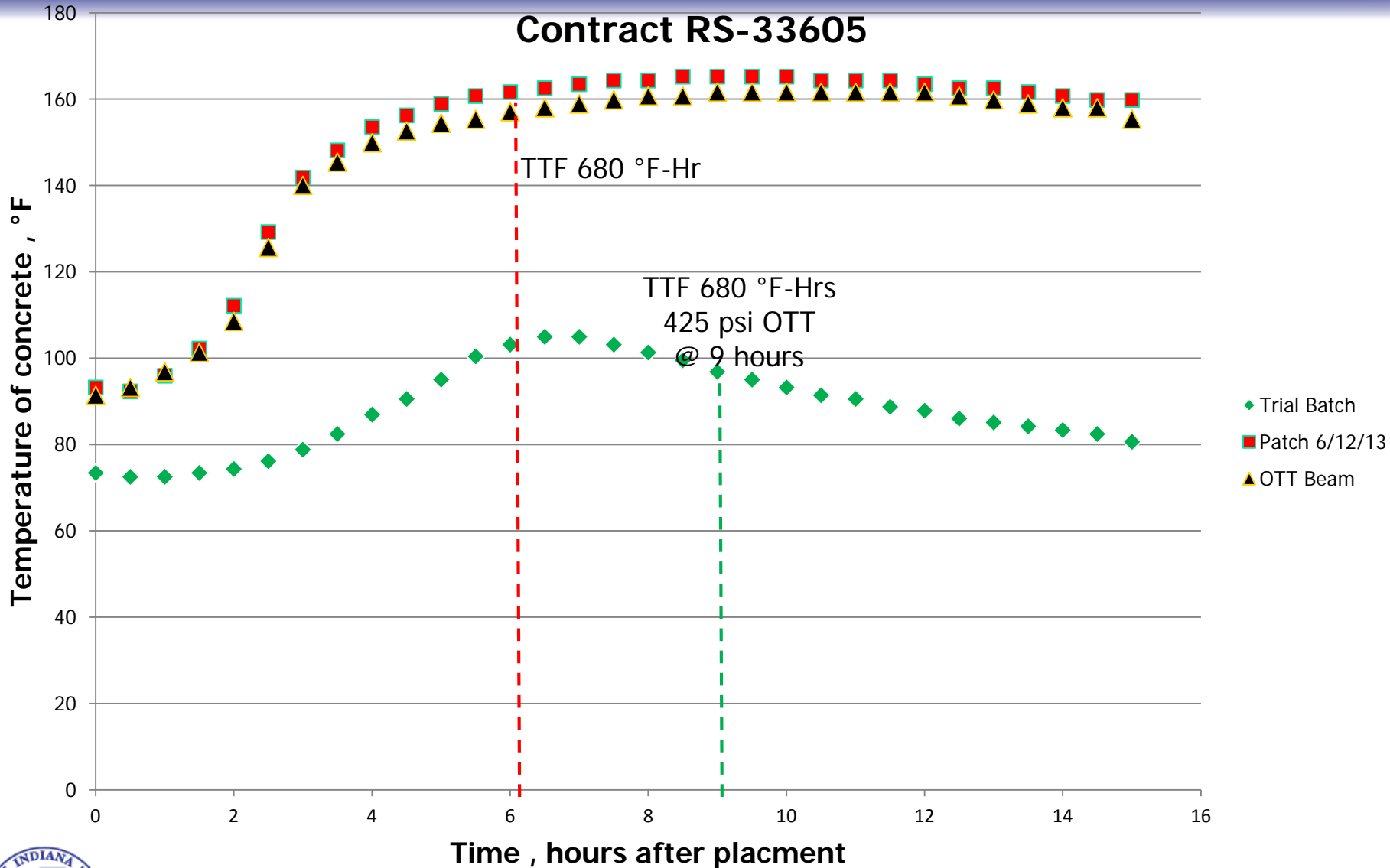
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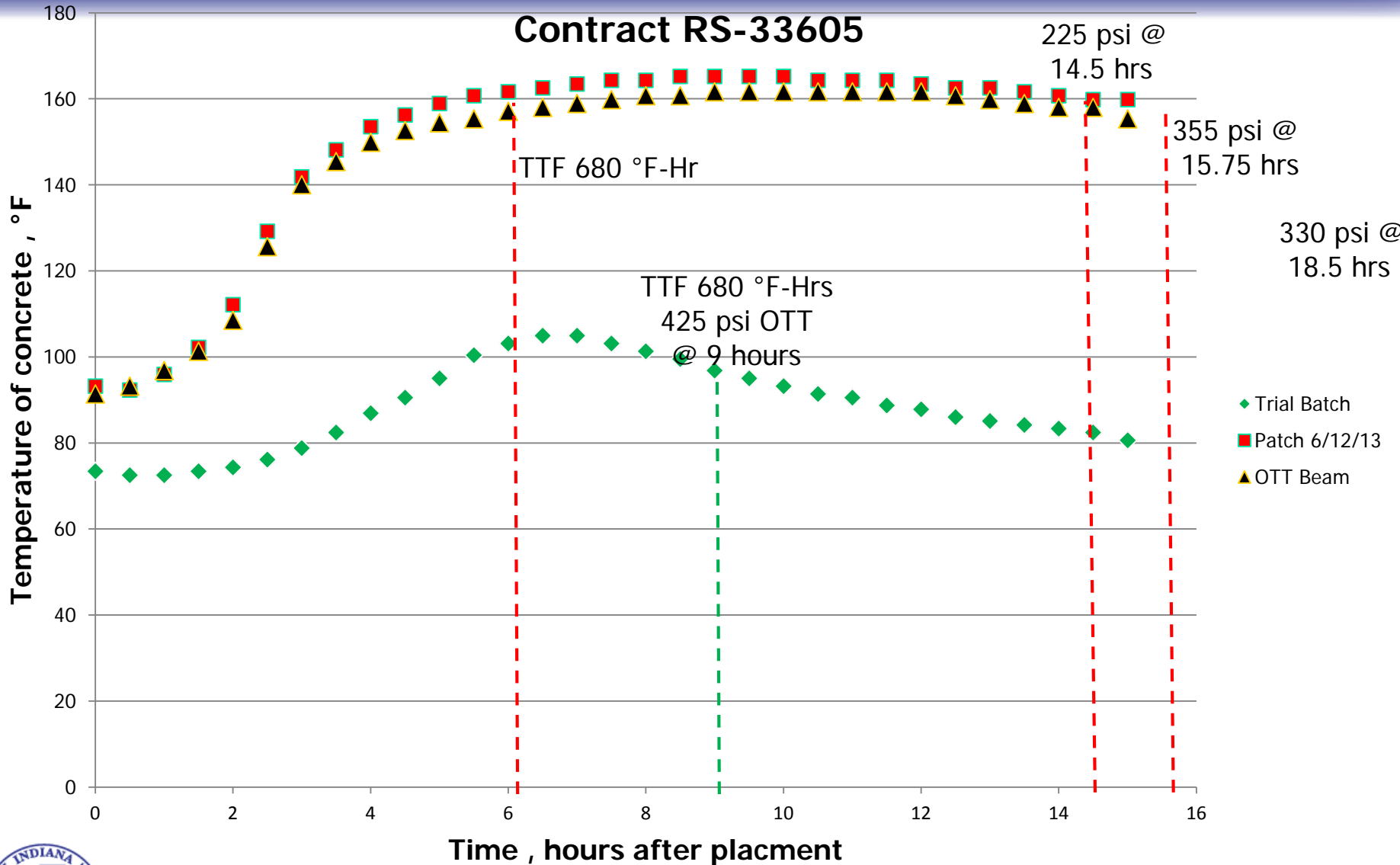
INDOT Experience with Maturity



INDOT Experience with Maturity



INDOT Experience with Maturity



INDOT Experience with Maturity

- **INDOT Research Study SPR-3905 entitled**
- **“Concrete Patching Materials and Techniques and Guidelines for Hot Weather Concreting”**
 - Improve mixture design, specification and construction practices
 - Examine methods to predict OTT with increased accuracy and reduced risk.
 - Examine issues associated with temperature fluctuations and flexural strength prediction.



