

# **“400” Series**

## **Specification Rewrite Subcommittee**

- John Barton (BMT)
- Leonard Bobrowski (AUS)
- Randy Cox (BRG)
- Peter Chang (FHWA)
- Heather Gilmer (CST)
- Gary Graham (CST)
- Jim Hunt (DAL)
- Gregg Freeby (BRG)
- David Head (ELP)
- Karl Janak (CST)
- James Kosel (CST)
- Kevin Pruski (BRG)
- Gerald Lankes (CST)
- Lisa Lukefahr (CST)
- Mark McClelland (BRG)
- Ronnie Medlock (BRG)
- Brian Merrill (BRG)
- Tom Rummel (BRG)
- Joe Roche (CST)
- John Vogel (HOU)
- Lloyd Wolf (BRG)
- Moon Won (CST)
- Sharon Slagle (BRG)
- Stephanie Williams (BRG)

# **“400” Series Reviewers**

- District Construction Engineers
- AGC Structures Committee
- Texas Aggregate and Concrete Association
- Precast Concrete Manufacturers Association
- Texas Concrete Pavement Association
- Cement Council of Texas
- Texas Quality Steel Council
- International Association of Foundation Drilling
- Others

# Specs Not Presented

no significant changes or only minor changes made

- Item 404, Driving Piling
- Item 405, Foundation Test Load
- Item 406, Timber Piling
- Item 407, Steel Piling
- Item 409, Prestressed Concrete Piling
- Item 422, Reinforced Concrete Slab
- Item 430, Extending Concrete Structures
- Item 438, Cleaning and Sealing Joints and Cracks  
(Rigid Pavement and Bridge Decks)
- Item 445, Galvanizing
- Item 448, Structural Field Welding

# Specs Not Presented

no significant changes or only minor changes made

- Item 450, Railing
- Item 452, Removing Railing
- Item 453, Temporary Railing
- Item 458, Waterproofing Membranes for Structures
- Item 461, Structural Plate Structures
- Item 465, Manholes and Inlets
- Item 471, Frames, Grates, Rings, and Covers
- Item 472, Removing and Re-laying Culvert and Storm Drain Pipe
- Item 473, Laying Culvert and Storm Drain Pipe
- Item 474, Slotted Drain

# Specs Not Presented

no significant changes or only minor changes made

- Item 476, Jacking, Boring, or Tunneling Pipe or Box
- Item 479, Adjusting Manholes and Inlets
- Item 480, Cleaning Existing Culverts
- Item 481, PVC Pipe for Bridge Drains
- Item 483, Scarifying Concrete Bridge Slab
- Item 490, Timber Structures
- Item 491, Timber for Structures
- Item 492, Timber Preservative and Treatment
- Item 497, Sale of Salvageable Material

# Main Focus of New Concrete Specs



- Update to state of the art
- Speed of construction
- Uniformity between structural and pavement concrete
- Prevent PCD

# What is PCD?

- Premature Concrete Deterioration due to ASR, DEF or both
- ASR: Alkali-Silica Reaction (the alkalis in the cement “dissolve” the aggregates)
- DEF: Delayed (or late) Ettringite Formation (an internal sulfate attack on the cement paste)





7-26-95

7-26-95

JARRIS 113.40

C 177-11-118 RFI RI

07/07/2004



006

Worker in a high-visibility vest and hard hat.

Worker in a high-visibility vest and hard hat.

Worker in a high-visibility vest and hard hat.

Worker in a dark shirt and hard hat.

Worker in a high-visibility vest and hard hat.

Excavator arm and bucket.

Red and white striped safety barrier.

165



# Item 421

## Hydraulic Cement Concrete

(pg. 516)

- **Not just a name change!**
  - reflects that Supplementary Cementitious Materials (SCMs) are important and provide added benefits to concrete

# Item 421

## Hydraulic Cement Concrete (cont.)

- **Major Changes**

- Will list and then explain in detail later

- **Other Big Changes**

- Will mention and provide reference only

# Item 421

## Hydraulic Cement Concrete (cont.)

### MAJOR Changes:

- Contractor responsible for certification of plant and trucks
- ACI 211 mix design (or other method acceptable), including strength over design
- Air entrainment tables
- New Table for Classes of Concrete

# Item 421

## Hydraulic Cement Concrete (cont.)

### MAJOR Changes:

- Plan note to specify sulfate resistant concrete; 4 mix design options
- 2 new ASR mix design options
- Contractor responsible for trial batches
- Compressive strength design/acceptance values

# Item 421

## Hydraulic Cement Concrete (cont.)

### Other Big Changes:

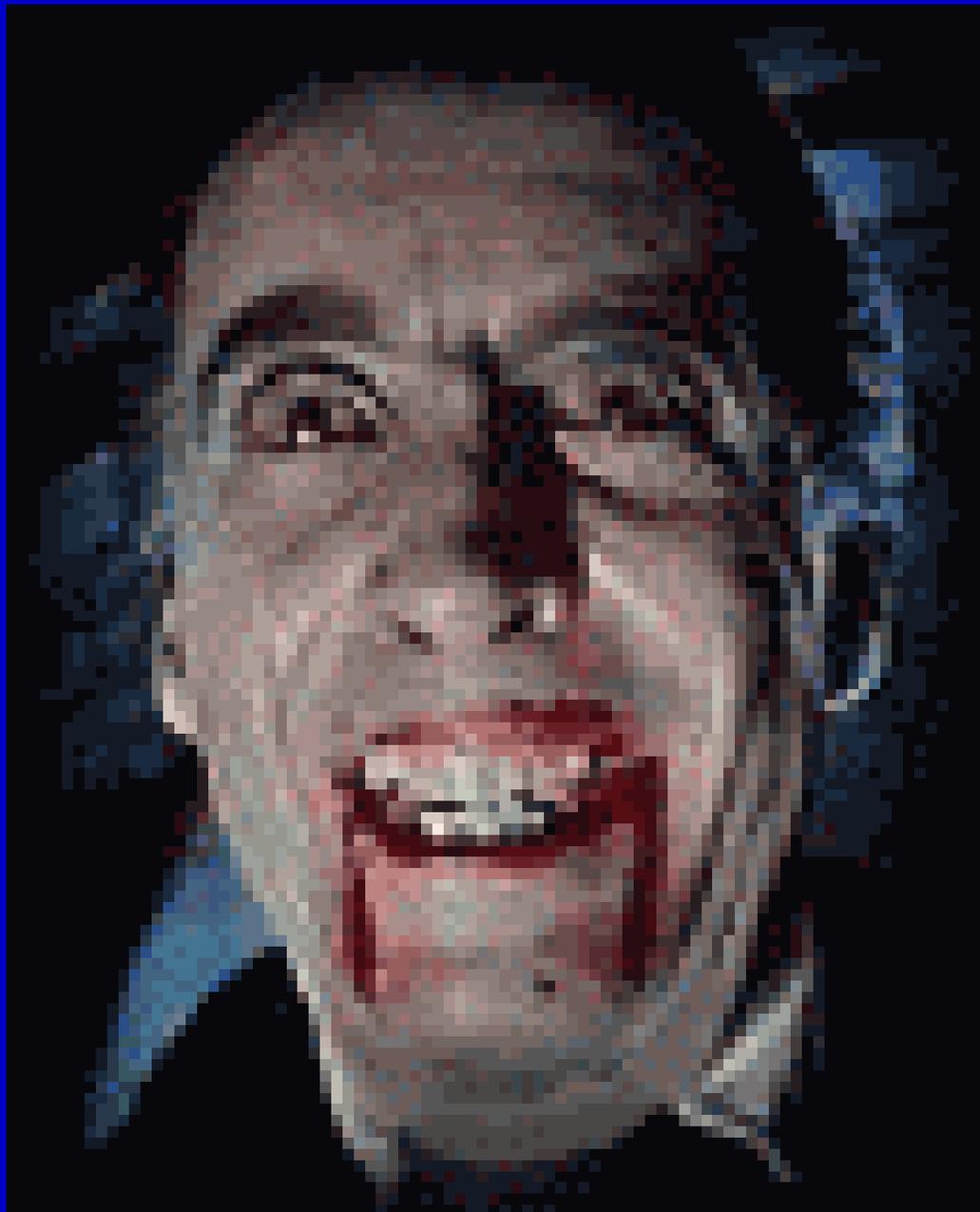
- 5-cycle Sodium Sulfate Soundness Testing removed (only Magnesium Soundness Testing) – pg. 518
- Decant limit for limestone in pavements raised – pg. 518
- New supplementary cementitious materials (SCMs): silica fume, ultra-fine fly ash (UFFA), metakaolin – pg. 516
- Aggregate Gradation in % Passing – pp. 519-520

# Item 421

## Hydraulic Cement Concrete (cont.)

### Other Big Changes:

- Item 437 Concrete Chemical Admixtures deleted: batching tolerances in Item 421 – pp. 525 & 530
- All plant and truck info. In Item 421 (was in Items 520 and 522) – pg. 520
- New uniformity test Tex-472-A – pp. 521 & 533
- Batch weight tolerances – pg. 530



## 421.3.A Concrete Plants and Mixing Equipment (Pg. 520)

- Contractor Responsibilities for Concrete Plants and Mixing Equipment
  - Weigh Batch Plant and Truck Mixers
    - MUST be NRMCA certified
    - Have inspection report signed and dated
    - Plants must be certified or inspected every 5 years OR whenever a plant is moved
    - Truck mixers must be certified or inspected every year



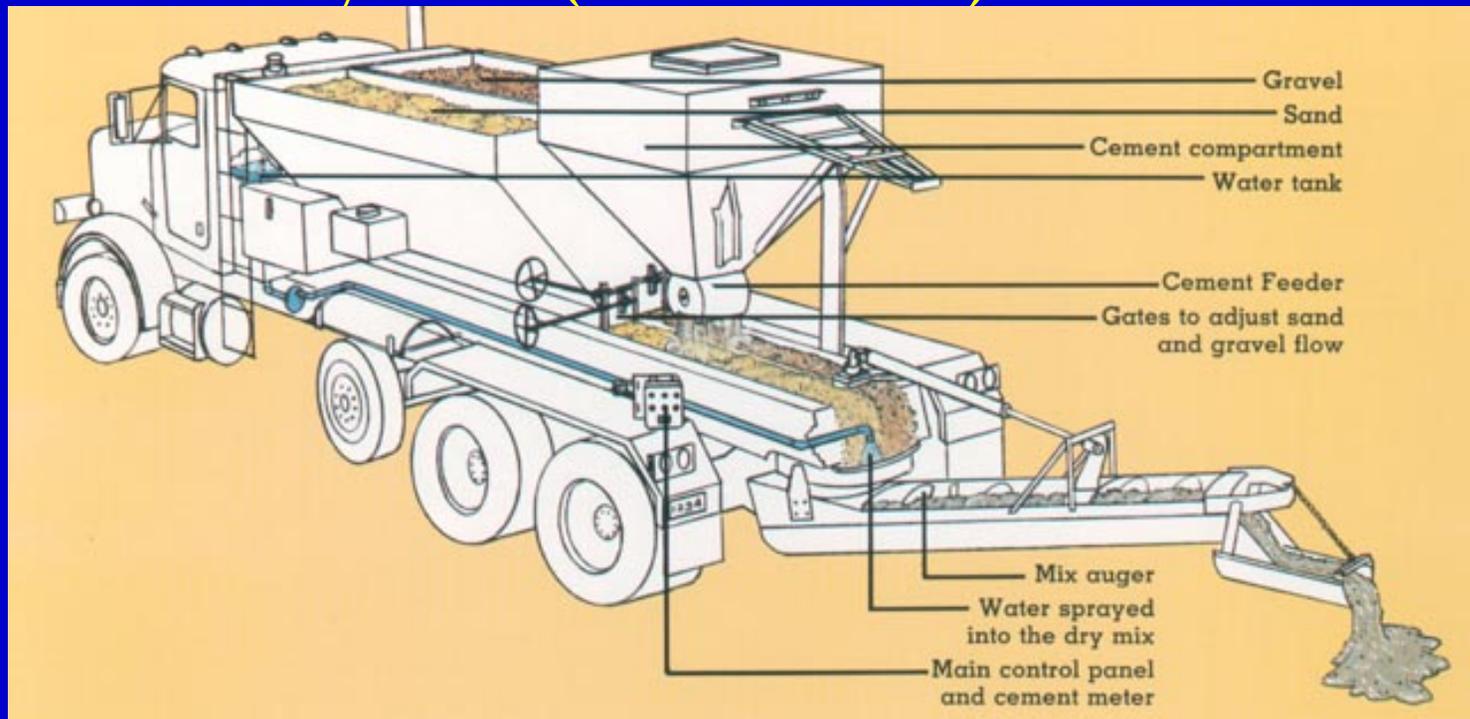
# 421.3.A.1 Scales (Pg. 521)

- Scales checked every 6 months
- Water batching and admixture dispensing equipment checked every 90 days



# 421.3.A.2 Volumetric Mixers (Pg. 521)

- VMMB capacity and performance
- Uniformity Test (Tex-472-A) test data



## 421.4.A Classification and Mix Design (Pg. 522)

- ACI 211 mix design OR other method approved by the Engineer
- w/c NEVER to be exceeded, regardless of strength
- Overdesign for strength in Table 6 (pg. 525)

# Table 6 Over Design (Pg. 525)

- Removed minimum cement content
- Accounts for production variability
- Design higher so that minimum required design strengths are met 99% of the time
- Based on ACI 318 overdesign



## Table 6 Over Design (cont.)

- Results from different mix designs may be used to calculate Std. Dev. as long as they are within 1000 psi of the specified strength from Table 5
- For example, if a concrete plant has records of 20 test results resulting in a standard deviation of 400 psi, they would have to add 580 psi to the Table 5 values to use as minimum values for the trial batch

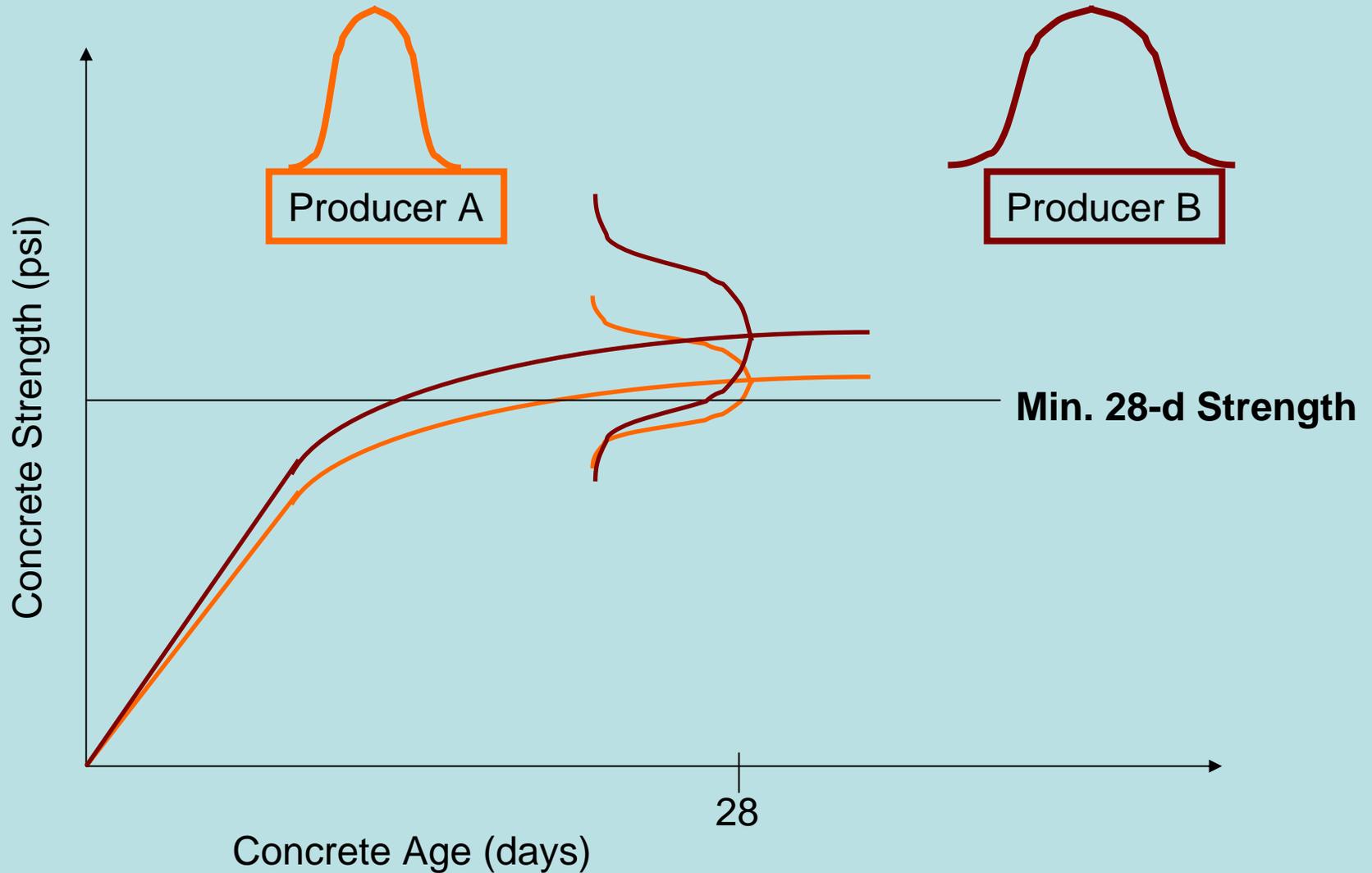
# Table 6 Over Design (cont.)

Table 6  
Over Design to Meet Compressive Strength Requirements<sup>1</sup>

No. of Tests <sup>2,3</sup>	Standard Deviation, psi				
	300	400	500	600	700
15	470	610	850	1,120	1,390
20	430	580	760	1,010	1,260
30 or more	400	530	670	900	1,130

1. When designing the mix, add the tabulated amounts to the minimum design strength in Table 5.
2. Number of tests of a concrete mixture used to estimate the standard deviation of a concrete production facility. Test of another mix within 1,000 psi of the specified strength may be used.
3. If less than 15 prior tests are available, the overdesign should be 1,000 psi for specified strength less than 3,000 psi, 1,200 psi for specified strengths from 3,000 to 5,000 psi and 1,400 psi for specified strengths greater than 5,000 psi.

# Table 6 Over Design (Pg. 525)



# 421.4.A.1 Cementitious Materials

## (Pg. 523)

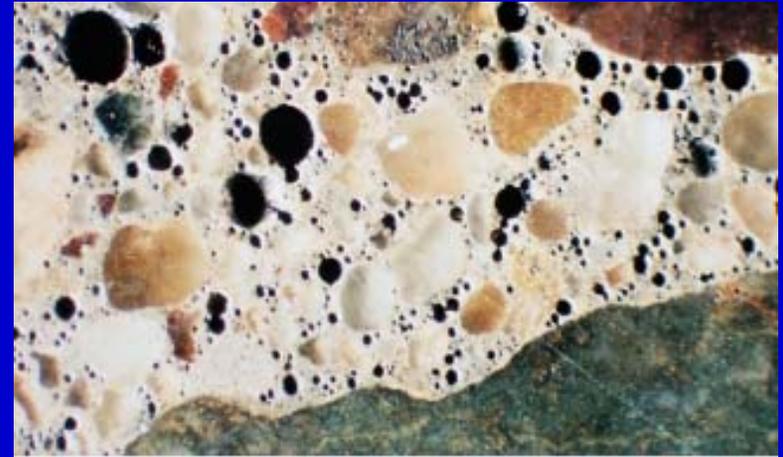
- Cement = cement + supplementary cementing material, if any
- 700 lb. max. of cement, unless specified or approved
- Sulfate-resistant concrete must be required by the plans
  - Mix design options 1-4
  - Types I/II, II, V or IP cement only
  - No Class C fly ash

# Table 5 Concrete Classes (Pg. 524)

- “Structural” concrete classes
  - Classes C, F, H, S, DC, CO, LMC, SS, K
  - Mix Design Options 1-8 for ASR prevention
- No minimum cement content unless specified
- Minimum design strength based on 28-day compression test (+ overdesign)
- Changes in maximum water-cement ratio
  - 1993 Spec Range: 0.32 (DC) to 0.98 (D)
  - 2004 Spec. Range: 0.40 (DC, CO, LMC) to 0.60 (A, B, D)

## 421.4.A.4 Air Entrainment (Pg. 525)

- All Classes except Class B are air-entrained unless shown on plans
- Severe exposure must be specified or shown on plans
- $-1\frac{1}{2}\%$  to  $+1\frac{1}{2}\%$  of target acceptable
- $+1\frac{1}{2}\%$  to  $+3\%$  of target may be accepted based on strength tests



## 421.4.A.4 Slump (Pg. 526)

- Minimum slump??
  - Lowest possible that can be placed and finished w/o segregation and honeycombing
- Maximum slump as shown in Table 8
  - Unless Engineer approves use of an admixture, w/c spec. limit is not exceeded, AND no excessive segregation or bleeding

# 421.4.A.6 Mix Design Options (Pg. 527)

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# 421.4.A.6 Mix Design Options (cont.)

- Structural Classes of Concrete

Opt 1      20-35% Class F ash

Opt 2      35-50% GGBFS

Opt 3      35-50% ternary blend (Class F, GGBFS,  
silica fume [UFFA and MK])

Opt 4      Ty IP or IS cement (10% replaced w/ Class  
F, GGBFS or silica fume [UFFA and MK])

# 421.4.A.6 Mix Design Options (cont.)

- Structural Classes of Concrete

Opt 5      35-50% ternary blend (Class C + >6% SF, UFFA or MK)

Opt 6      Lithium Nitrate

Opt 7      Straight cement: total alkali < 4 lb./cu.yd.

Opt 8      Anything goes as long as proven safe by modified ASTM C 1260



ASTM C 1260

ed

me

or

## 421.4.A.6 Mix Design Options (cont.)

- Non Structural Classes of Concrete – sulfate resistance NOT specified

Opt 1      20-35% Class F **OR** Class C ash

Opt 2      35-50% GGBFS

Opt 3      35-50% ternary blend (Class F **or** Class C, GGBFS, silica fume [UFFA and MK])

Opt 4      Ty IP or IS cement (10% replaced w/ Class F **or** Class C, GGBFS or SF [UFFA and MK])

Opt 5      35-50% ternary blend (Class C + >6% SF, UFFA or MK)

Opt 6      Lithium Nitrate

Opt 7      Straight cement: total alkali < 4 lb./cu.yd.

Opt 8      Anything goes as long as proven safe by modified ASTM C 1260



# 421.4.B Trial Batches (Pg. 528)

- Contractor responsibility
  - Air content testing
  - Slump testing
  - Strength testing\* (3 sets of 2 specimens)
  - Engineer must be given the opportunity to witness trial batch AND testing
  - 7-day target value established
  - Strength-Maturity relationship developed by Contractor

\* If mix contains silica fume, extra cylinders must be made and sent to CST/M&P to verify complete dispersion (pg. 532)

## 421.4.B Trial Batches (cont.)

- Why develop a 7-day target strength?
  - Refer to governing specification (eg., Item 420)
  - Hasten construction decisions
  - No “time penalty” for the use of SCMs that delay early strength

7-Day Target value =

$$\text{Design str. (Table 5)} \times \frac{\text{7-d trial batch strength}}{\text{28-d trial batch strength}}$$

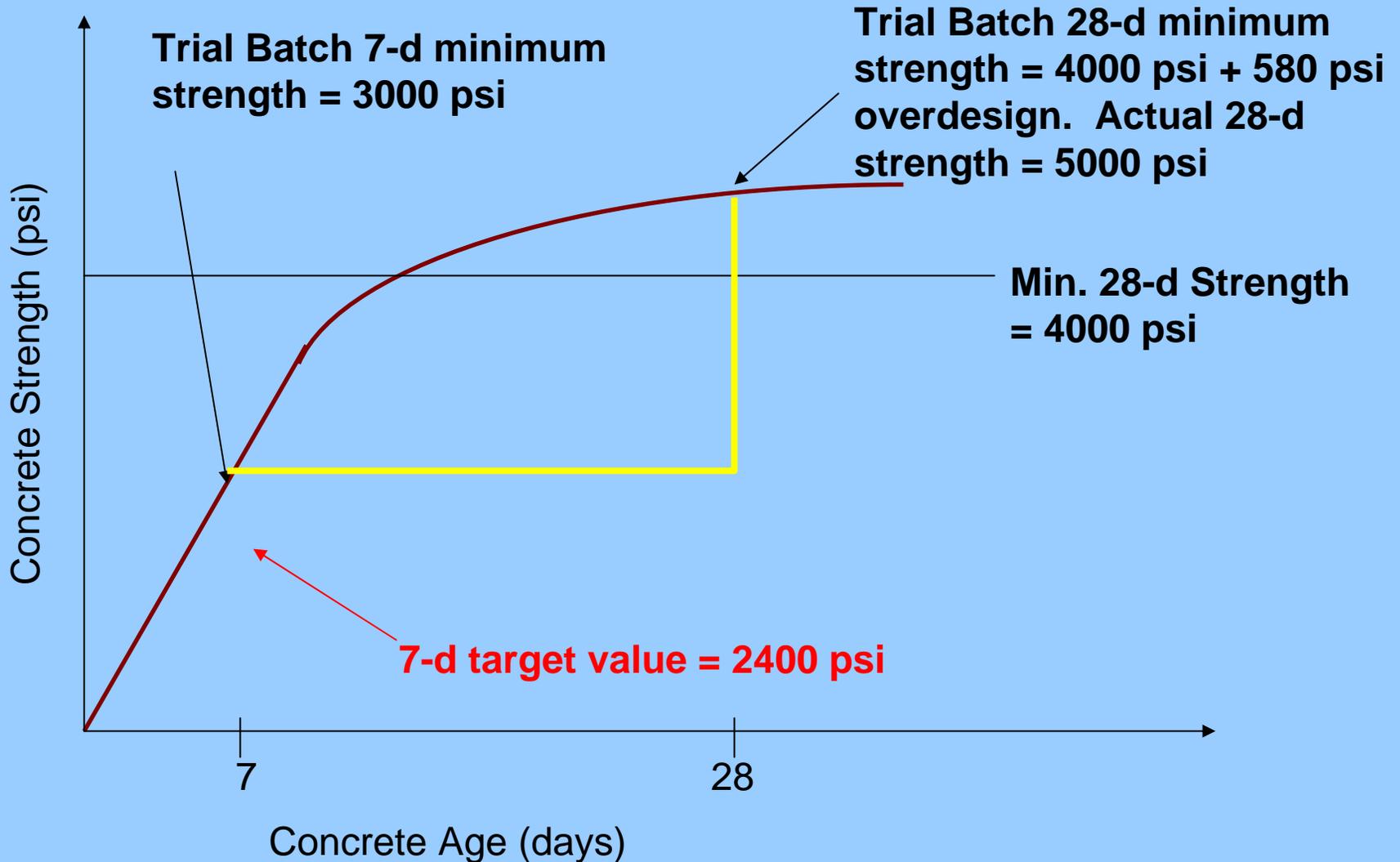
# 7-Day Target Value (cont.)

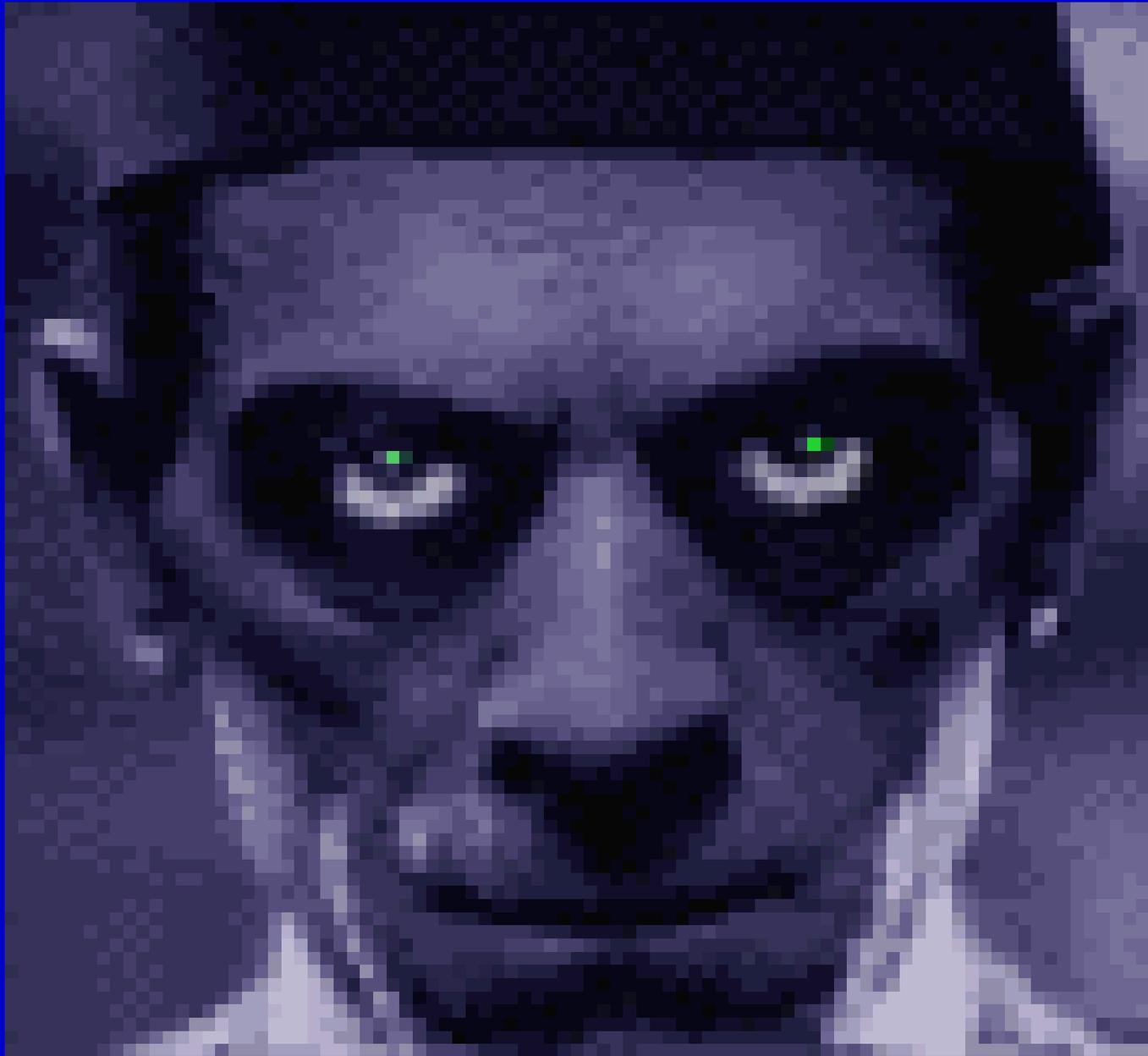
- Example: Table 5 minimum 28-d strength is 4000 psi. Overdesign is 580 psi. Trial batch 28-day target is 4580 psi.
- Actual 28-day trial batch strength is 5000 psi and 7-day trial batch strength is 3000 psi,
- 7-day target value during production will be:
- 7d target  $= 4000 \times \frac{3000}{5000}$   
 $= 2400 \text{ psi}$

# 7-Day Target Value (cont.)

- Remember:
  - For “structural” classes of concrete, the 28-day minimum compressive strengths must always be met, regardless of 7-day target
  - Specific action resulting from 7-day target testing is in accordance with governing spec.

# 421.4.B Trial Batches (cont.)





# Review of Strength Requirements

- 28-day design strength (Table 5)
- 28-day trial batch strength (Table 5 + overdesign)
- Acceptance strength
  - Structural concrete: 28-day design strength
  - Non-structural: 7-day target strength

# 421.4.E Mixing and Delivering Concrete (Pg. 531)

- Material coming to the project in mix trucks may be tested for slump uniformity when a concern
  - Slump tests at 15% and 85% of load
  - Table 11 Slump Tolerance
  - Contractor responsible for testing
  - Slump uniformity a QUICK check of uniformity  
(Tex-472-A the full uniformity test)

# 421.4.E Mixing and Delivering Concrete (cont. Pg. 532)

- Addition of water or admixtures at job only allowed with truck mixers AND with a full load

# 421.4.E.1-5 Mixing and Delivering Concrete (cont. Pg. 532)

1. Central-Mixed Concrete: mixing time of 1 minute for 1<sup>st</sup> cu.yd. and 15 seconds for each additional cu.yd. of CAPACITY
  - Shorter times used only after Tex-472-A validates shorter mixing times
2. Truck-Mixed Concrete: Maximum of 300 revolutions (minimum 70-100 revolutions with satisfactory uniformity)

# **421.4.G.3 Testing of Hardened Concrete (Pg. 534)**

**“Only compressive strength testing will be used unless otherwise specified or as shown on plans.”**

# 421.4.G.4 Certification of Testing Personnel (Pg. 534)

- Contractor must provide certified testing personnel (ACI or TxDOT approved equivalent)
- Contractor testing responsibilities listed in controlling Items

# 421.4.G.5 Adequacy and Acceptance of Concrete (Pg. 535)

- “Structural” concrete tested by TxDOT at 7-day and 28-day.
  - 28-day for acceptance
  - 7-day for evaluation of adequacy based on 7-day target value developed in trial batch
- All other concrete (except “P”) will be accepted by 7-day strengths

Brian,  
Are we done  
yet??



We're just  
getting warmed  
up!!





# Significant Changes to Items 360, 361 and 368

# Item 360, “Concrete Pavement” (Pg. 416)

- Reorganized and consolidated
- 7-day (flexural or compressive) OR 28-day (flexural or compressive) design/job strength

<b>Design Strength – pg. 416</b>			<b>Job Control Strength – pg. 421</b>	
	<b>7-day</b>	<b>28-day</b>		<b>7-day*</b>
<b>flexural</b>	<b>570</b>	<b>680</b>	<b>flexural</b>	<b>520</b>
<b>compressive</b>	<b>3500</b>	<b>4400</b>	<b>compressive</b>	<b>3200</b>

\* 7-day proven to meet 28-day design requirements

# Item 360, “Concrete Pavement”

- HES concrete used for “Fast Track” pavements 24-hr strengths (unless otherwise shown on plans or specified) – pg. 416
- Tie Bars: Use only multiple-piece or drill & epoxy as shown on plans – pg. 417
- Requirement for “Paving and Quality Control Plan” added – pg. 420

# Item 360, Cont'd.

- Job Control Testing: Unless waived on the plans, will be conducted by the contractor – pg. 420
- Job-Control Strength – pg. 421
  - Single result  $>10\%$  below or 3 consecutive below job-control strength requires investigation and correction
  - Single result  $>15\%$  below required job-control strength, “Engineer will evaluate the structural adequacy...”
  - Split-sample verification testing at least 1 per 10 job-control samples
    - Corrective action when difference exceeds Table 1 or when average of 10 job-control tests and Engineer’s split-sample differ by more than 10%

# Item 360, Cont'd.

- Concrete Delivery – pg. 424
  - Agitated concrete placed within 60 minutes
  - Non-agitated concrete within 45 minutes
  - In hot weather or conditions causing quick set, times may be reduced by Engineer.
  - Times may be extended if contractor can demonstrate that the concrete can be properly placed, consolidated & finished without adding water.

# Item 360, Cont'd.

- Date Imprinting – pg. 425
  - Contractor will imprint date at beginning of each placement. Contractor may also imprint name or logo with date.
- Metal tine texturing required unless otherwise shown on the plans – pg. 426
  - This allows districts to delete this requirement on lower speed roadways.
- Sawing Joints: Saw joints as soon as can be accomplished to avoid uncontrolled cracking. – pg. 428. Minor raveling of the cut is acceptable.

# Item 360, Cont'd.

- Opening to traffic – pg. 429
  - Open to all traffic after 7 days (3 curing days)
  - Unless otherwise shown on the plans, open to construction equipment after 48-hr AND early opening strength. Restore damaged membrane curing as soon as possible.

# Item 360, Cont'd.

- Early opening to all traffic – pg. 429
  - Contractor responsible for all testing (test result interpretation subject to Engineer approval)
  - Maturity strength estimates or concrete specimens cured under same conditions as pavement
  - 3 curing days (curing day changed from calendar day to 24-hour period and coordinated with Item 420) AND
  - 450 psi flexural or 2800 psi compressive
  - HES concrete may be opened after 24 hours AND specified strength

# Item 360, Cont'd.

- Pavement Thickness – pg. 430
  - Engineer checks every 500 feet with Tex-423-A, or other methods as shown on the plans
  - Core where directed to verify deficiencies of more than 0.2 in. from plan thickness
  - If core is  $>0.2$  and  $<0.75$  inches from plan thickness, 2 addl. cores
    - Average of 3 cores, Table 2 Price Adjustment Factor – pg. 432
  - If core  $>0.75$  in. deficient, core every 10-ft each direction to determine limits of deficient area
    - Any area  $>0.75$  and  $<1$  in. evaluated by Engineer: remove and replace, retain without compensation
    - Any area  $>1$  in. deficient: remove and replace

# Item 360, Cont'd.

- Bid Codes – Continuous or Jointed, Depth; or Curb (Type).

# Item 361, “Full-Depth Repair of Concrete Pavement”

- Use Class “HES” when timeframe for opening to traffic is specified to be within 72 hours of placement. Otherwise, use Class “P” in accordance with Item 360.
- Changed repair area width from full lane width to half lane width to address maintenance special provision which allows half lane width repairs.
- Eliminated the field tiebar bond test. Added the requirement that the tiebar hole be filled with epoxy before installing the tiebar.
- Bid Codes – Continuous or Jointed, Depth.

# Item 368, “Concrete Pavement Terminals”

- Makes significant use of other items that have been significantly revised, particularly Items 360 and 421.
- Rewritten as a more generic specification to include concrete pavement terminals with the Wide Flange Beam system, developed by HOU, and the expansion joint system that DAL developed.

**DO NOT CLICK**





Item 420 – Concrete Structures

# Item 420, Concrete Structures

- Like 360, the contractor will perform some “job control” testing
- Equipment: saw grooving eqpt, skewed screeds are required for  $>15^\circ$ , compression testing eqpt (pp. 483-485)



- Formwork drawings: required to submit (PE sealed) but approval not required (p. 488)





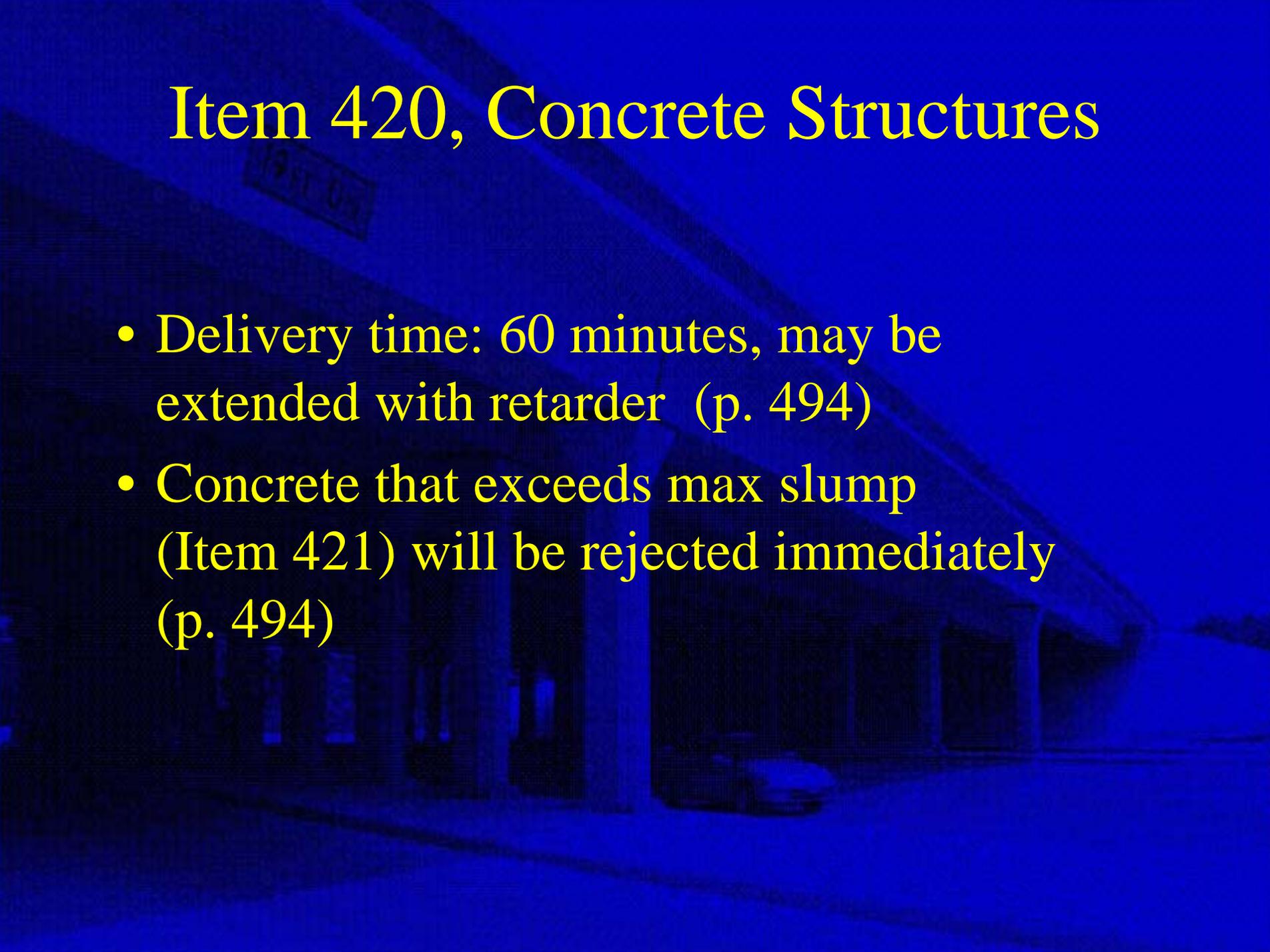
# Item 420, Concrete Structures

## Schedule Restrictions (pp. 486-488)

- Form removal: 2500 psi, no days
- Placing beams: 3000 psi, no days
- Full construction traffic allowed with full strength, continued curing
- Opening to decks to traffic: get design strength, complete curing, apply surface treatment - no days
- Placing bridge rails: 3000 psi, no days

Contractor performs tests for these operations, maturity can be used for all of these

# Item 420, Concrete Structures



- Delivery time: 60 minutes, may be extended with retarder (p. 494)
- Concrete that exceeds max slump (Item 421) will be rejected immediately (p. 494)

# Item 420, Concrete Structures

- Concrete placement temperatures (p. 494):
  - » Structural concrete: 50F to 95F
  - » Slab concrete: 50F to 85F
  - » Mass Concrete: 50F to 75F
  - » Min. value of 60F if slag is used
- Mass concrete: 5' or greater, can be designated on the plans, separate pay item (p. 500)
- Forms for mass concrete stay in place for 4 days



# Item 420, Concrete Structures

- Curing: no change in duration, can perform other operations (bridge rails,...) prior to completion if curing is maintained (pp.509-511)
- Ordinary surface finish now in 420 (p. 512)
- Understrength review/pay adjustment procedure (Templeton memo) now in specs (p. 515)

# Item 420, Concrete Structures

- Bridge deck finishing & curing (pp. 506-509):
  - » screed, float and check w/ straightedge
  - » apply broom, burlap or carpet drag asap (microtexture)
  - » apply evaporation retarder asap
  - » apply curing compound when water sheen is gone
  - » wet mats
  - » saw grooving at completion of curing (macrotexture)

# Item 420, Concrete Structures



Screeding

# Item 420, Concrete Structures



Fogging - yes

# Item 420, Concrete Structures



Fogging – No

# Item 420, Concrete Structures



Floating

# Item 420, Concrete Structures



Carpet Drag for microtexture

# Item 420, Concrete Structures



Broom finish for microtexture



Interim Cure

# Item 420, Concrete Structures



Wet Mat Cure

# Item 420, Concrete Structures



Clear Plastic

# Item 420, Concrete Structures



**Black Plastic**

# Item 420, Concrete Structures



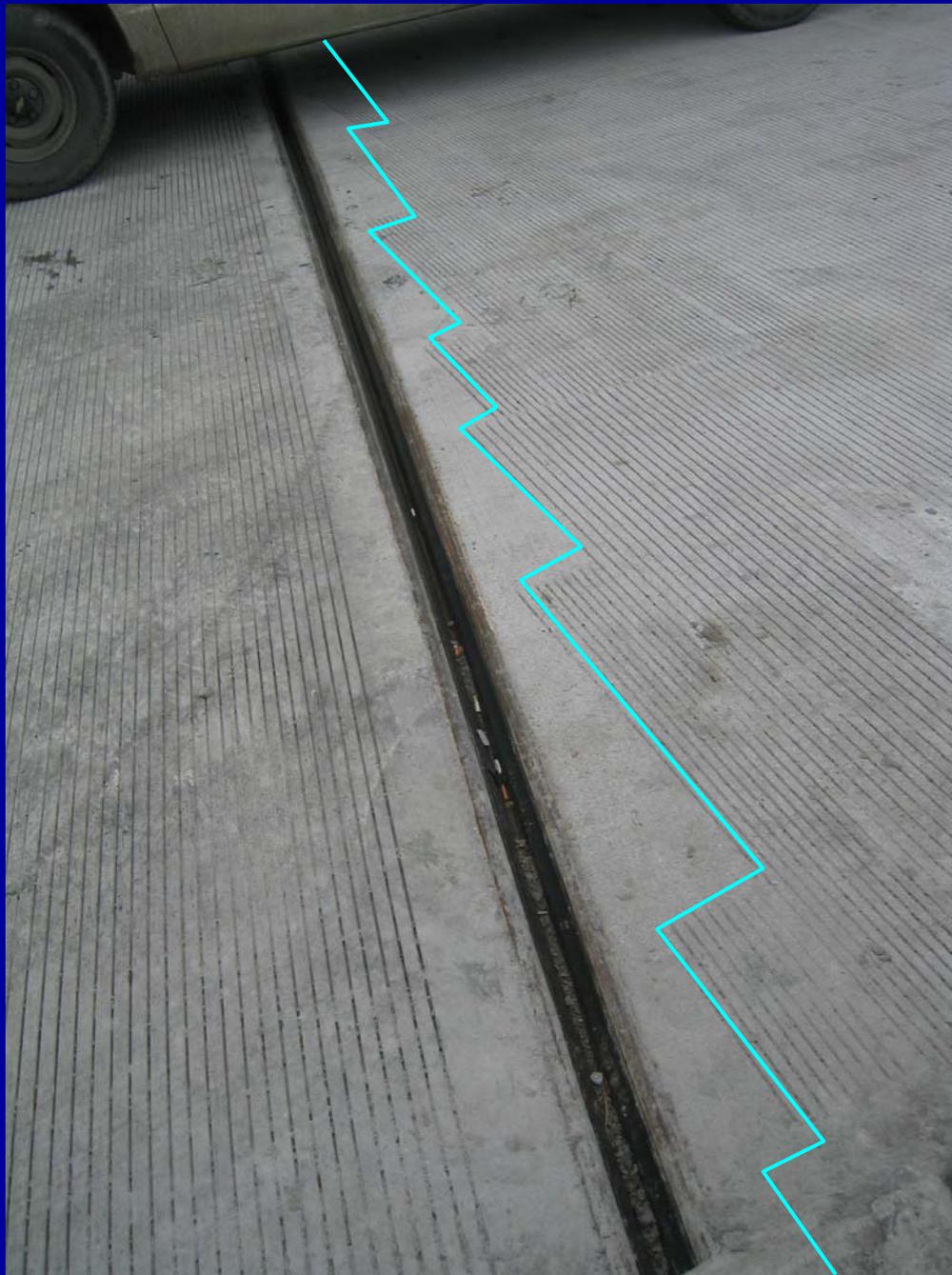
Sawing Grooves - macrotexture

# Item 420, Concrete Structures



Saw-grooving - the new result

# Item 420, Concrete Structures



Saw-grooving -  
the new result

# Item 420, Concrete Structures



Tining – the old way

# Item 420, Concrete Structures



Tining – the old result

# Item 420 – New Bid Codes

- 0420 2001 CL A CONC (MISC)CY
- 0420 2002 CL B CONC (FLUME)CY
- 0420 2003 CL C CONC (ABUT)CY
- 0420 2004 CL C CONC (BENT)CY
- 0420 2005 CL C CONC (FOOTING)CY
- 0420 2006 CL C CONC (RAIL FOUNDATION)CY
- 0420 2007 CL C CONC (CULV)CY
- 0420 2008 CL C CONC (WINGWALLS)CY
- 0420 2009 CL C CONC (HDWL)CY

# Item 420 – New Bid Codes

- 0420 2010 CL C CONC (SIGN COLUMN)CY
- 0420 2011 CL C CONC (RETAINING WALL)CY
- 0420 2012 CL C CONC (PILE ENCASEMENT)CY
- 0420 2013 CL C CONC (MISC)CY
- 0420 2014 CL C CONC (CURB OUTLET) (TY I)EA
- 0420 2015 CL C CONC (CURB OUTLET) (TY II)EA
- 0420 2016 CL C CONC (COLLAR)EA
- 0420 2017 CL C CONC (BENT) (MASS PLACEMENT)CY

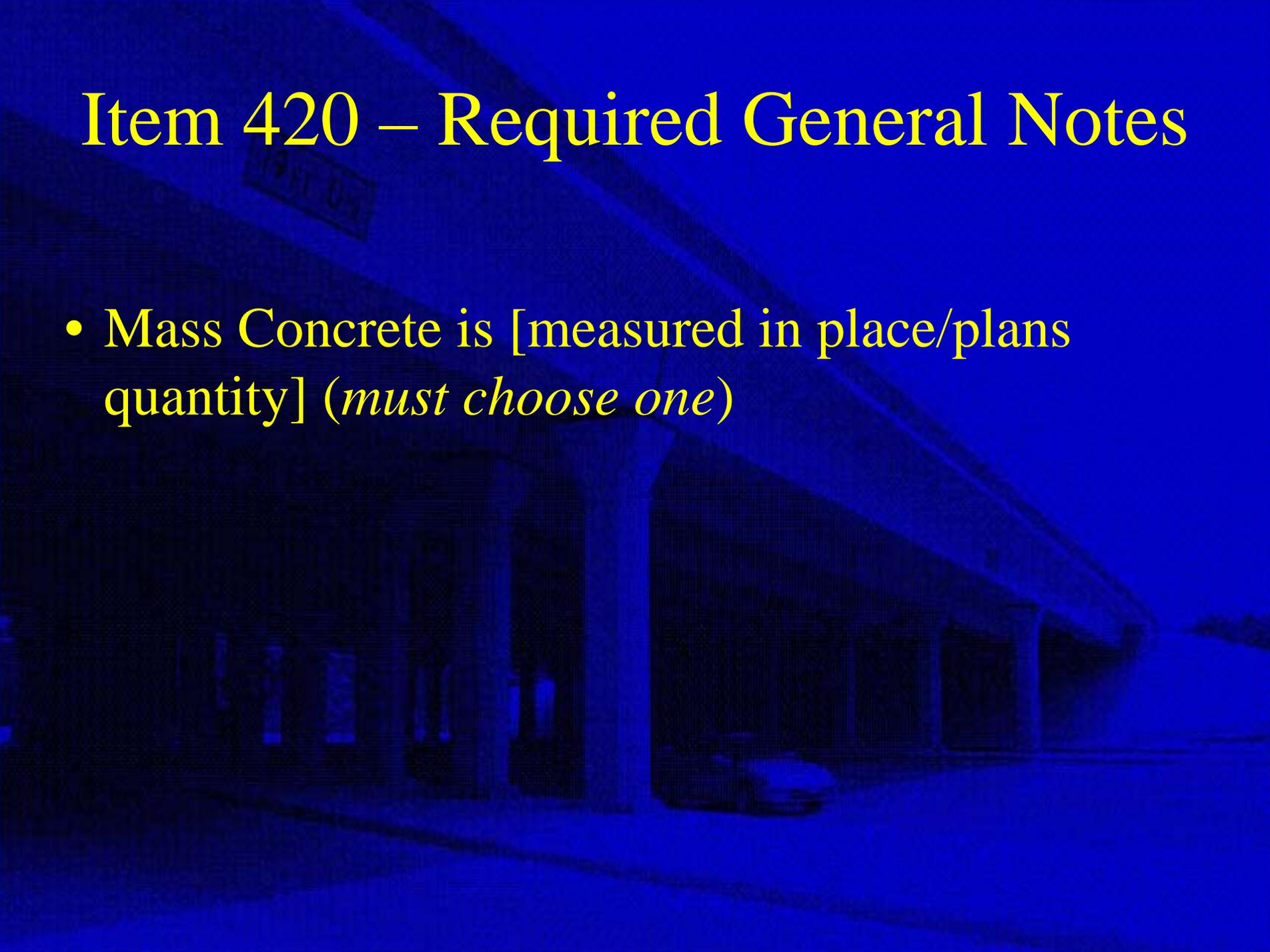
# Item 420 – New Bid Codes

- 0420 2018 CL C CONC (FOOTING) (MASS PLACEMENT)CY
- 0420 2019 CL C CONC (CAP)CY
- 0420 2020 CL C CONC (CRASHWALL)CY
- 0420 2021 CL C CONC (COPING)CY
- 0420 2022 CL E CONC (SEAL)CY
- 0420 2023 CL F CONC (COLUMN)CY
- 0420 2024 CL F CONC (BENT) (MASS PLACEMENT)CY
- 0420 2025 CL F CONC (FOOTING) (MASS PLACEMENT)CY

# Item 420 – New Bid Codes

- 0420 2026 CL F CONC (FOOTING)CY
- 0420 2027 CL F CONC (BENT)CY
- 0420 2028 CL H CONC (BENT)CY
- 0420 2029 CL S CONC (SLAB)CY
- 0420 2030 CL S CONC (PAN GIRD)CY
- 0420 2031 CL S CONC (SHEAR KEY)CY
- 0420 2032 CL S CONC (CULV DIR TRAF)CY
- 0420 2033 CL S CONC (APPR SLAB)CY
- 0420 2034 CL S CONC (BRIDGE SDWLK)CY
- 0420 2035 CL S CONC (CIP SLAB SPAN)

# Item 420 – Required General Notes



- Mass Concrete is [measured in place/plans quantity] (*must choose one*)

# Item 420 – Optional Gen. Notes

- Use Class `_ Concrete` for the following items:  
*(if the default classes aren't used)*
- Type [I-D/2] *(pick one or both)* curing compound may be used for the following elements: *(when curing compound is permitted, if not permitted, use the next note)*
- Do not use curing compound on structural elements

# Item 420 – Optional Gen. Notes

- In-water placement will be allowed (*default doesn't allow it*)
- The Engineer will perform testing for schedule restrictions (*default is for Contractor to perform this testing*)
- Provide Ordinary Surface Finish to the following elements: (*see 420.4.M for default list*)
- The following elements are Plans Qty elements: (*see Table 2 for default list*)



**Item 400**  
**Excavation and Backfill for**  
**Structures**

# Item 400 – Excavation and Backfill for Structures

- Can be pay item or subsidiary
- Sets pay limits for overexcavation (check out Table 1, pg. 449)
- Fewer standard pay items
- Must set up Item 401 if flowable fill is to be used.

# Item 400 – General Notes

No required General Notes

Optional General Notes:

- Structural excavation is a pay item (default is subsidiary)

# Item 400 – Bid Codes

Structural Excavation

Structural Excavation (Bridge)

Structural Excavation (Box)

Structural Excavation (Pipes)

Cement Stabilized Backfill

Cutting and Restoring Pavement

# Item 401 Flowable Backfill



# Item 401 – Flowable Backfill

- A new Item based on the 1993 SS 4438
- The mix design and the locations must be shown on the plans
- Also a bid item

Item 402

# Trench Excavation Protection



# Item 402 – Trench Excavation Protection

- Use only for buried pipes,... not for wall construction (use 403)
- Still a pay item by the linear foot

# Item 403 – Temporary Special Shoring

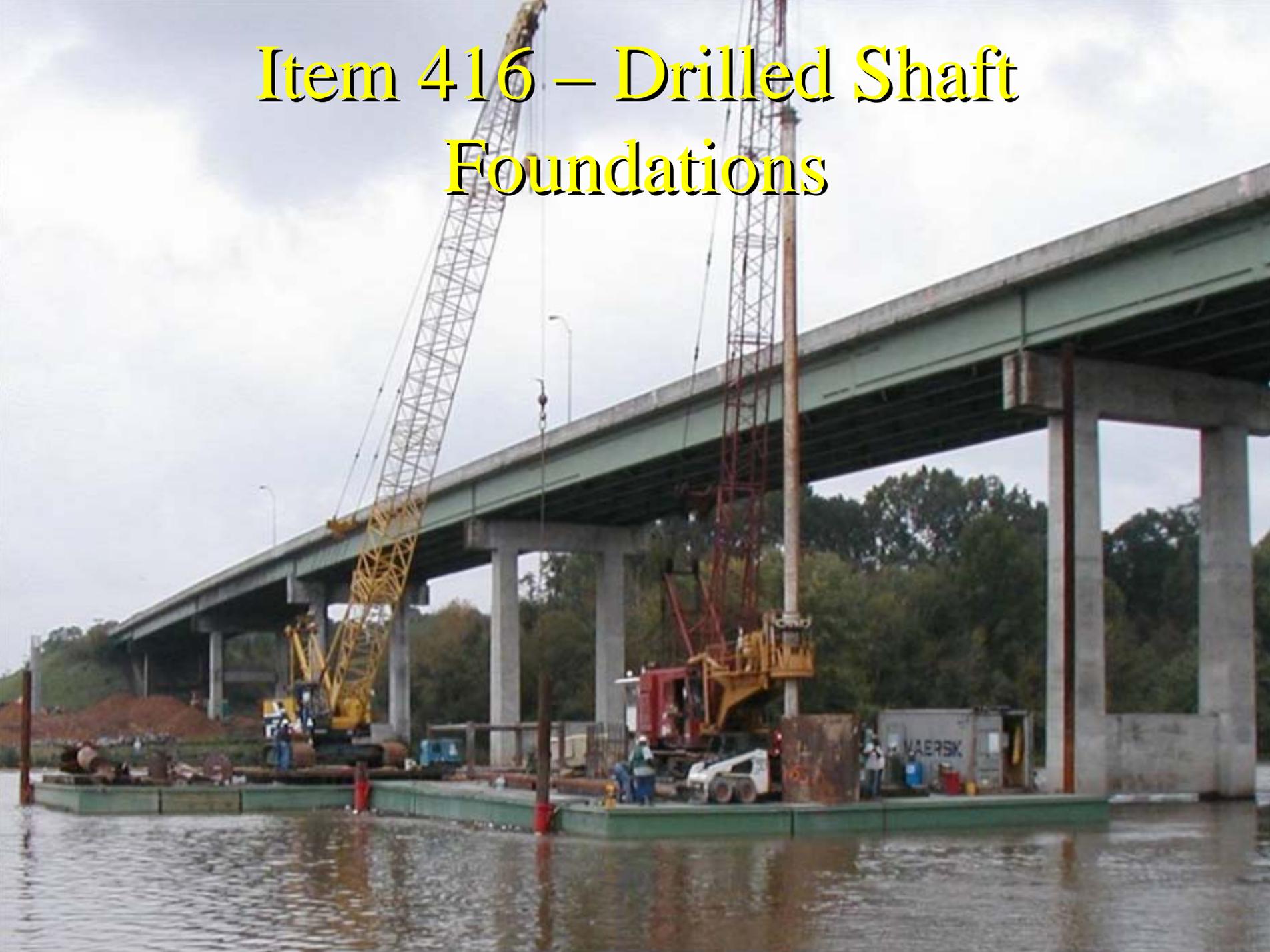


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# Item 403 – Temporary Special Shoring

- Used for walls, footings, and other excavations not associated with pipes
- Measured in place (no longer plan qty) (p. 453)
- Temporary MSE walls referred to Item 423
- Shoring design/details required to be signed/sealed/submitted but approval is not required
- Only one pay item

# Item 416 – Drilled Shaft Foundations



# Item 416 – Drilled Shaft Foundations

- New requirements for slump (p. 473), aggregate sizes (p. 473), rebar extensions for overdrilling (p. 476,477)
- Slump loss test (p. 473)
- Disallow Polymer slurries (p. 474)
- Mass Concrete provisions don't apply (p. 477)
- Can free fall in dry shafts >24" (p. 478)
- Modified definition of "Max Plan Length Shaft" (p. 481)
- All core holes paid at \$125/each (p. 481)



JUN 5 2003



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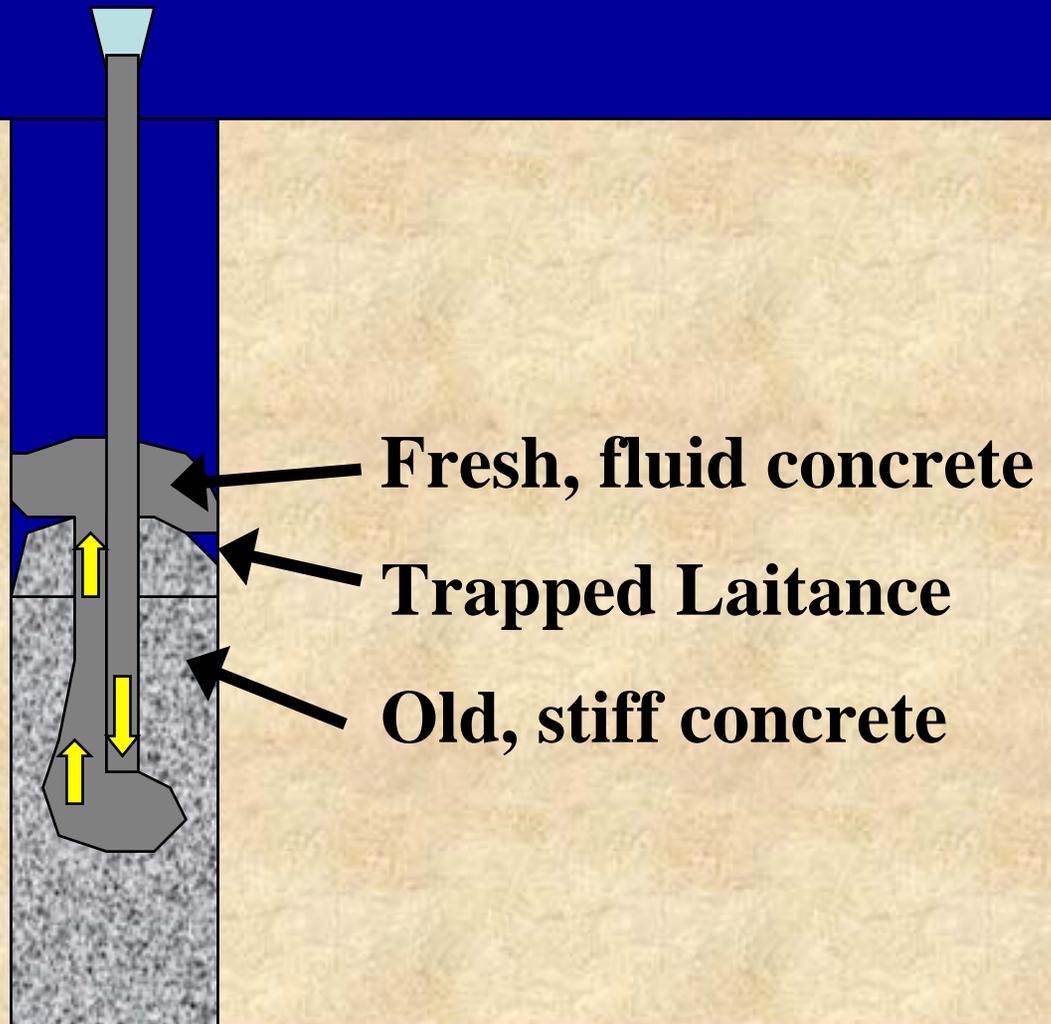
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# Loss of Workability – Slump Loss Test



# Item 416 – General Notes

No required general notes

Optional General Note:

- The slurry displacement method is not allowed (default allows it)

# Item 416 – Bid Codes

Drilled Shaft – X dia

Drilled Shaft (Non reinforced) (X dia)

Drilled Shaft (Sign Mount) (X dia)

Drilled Shaft (High Mast Pole) (X dia)

Bell Footings

# Item 423 – Retaining Walls



anced rendering  
all to be built using  
local townspeople.

# Item 423 – Retaining Walls

- Included requirements for temporary MSE and Concrete Block walls (p. 545, 546)
- Use Cement-stabilized backfill only when required in the plans or as approved (p. 540)
- Compaction increased to 95% of Tex-114-E (p. 544)
- Review plumbness of each row of panels (p. 543)

# Item 423 – Retaining Walls

- Shimming limits to account for non-level pads (p. 543)
- Modify backfill or compaction method to achieve density requirements (p. 544)
- If epoxy coating is required for earth reinforcement, panel and coping rebar also needs to be epoxy-coated (p. 541)

# Item 423 – Retaining walls

- Backfill changes
  - Type A – new - high quality material (\$\$)
  - Type B – same as Type A from 93 specs – the default backfill for most applications
  - Type C – default for temporary MSE walls – similar to the Type B in the 93 specs
  - Type D – new – free draining material for walls subject to inundation

# Item 423 – General Notes

- Required: BRG maintains a list of approved suppliers of MSE and Concrete Block retaining wall systems – see the standardized general notes for this list
- Optional: To change the backfill from the default Type B to another type.
- Make sure that temporary walls are ID'd on the plans and the bid codes

# Item 424 – Precast Concrete Structures (Fabrication)



# Item 424

- Now covers project-specific casting operations in addition to multi-project (commercial) operations (p. 548, 549)
- DMS – 7300 supplements the spec
- Several differences in QC/QA between project specific and multi-project operations
- Also defines major and minor prestressed members (p. 548)
- Covers non-stressed products as well

See page 146 of the handouts for spreadsheet

## Item 424 – Pg. 548

- Multi-Project Fabrication Plant: Offsite facility that produces members for more than one Contract (Commercial plants)
- Project-Specific Fabrication Plant: temporary facility that produces members for only one Contract. May be applied to plants that produce for multiple contracts if approved (Job site casting)

# Item 424 – Pg. 548

- Major Prestressed Members: I-beams, U-beams, Bulb-Tee beams, Voided Box beams
- Minor Prestressed Members: All other P/S members such as deck panels, slab beams, piling

# Item 424

- Revised rejection criteria for bridge deck panels (p. 566)
- Provided tolerances for non-MSE wall panels (Table 3, p. 569)
- Maximum internal temperature during curing is tied to mix design (p. 562)
- Maximum concrete temperature of 95° for placement (p. 555)

# Item 424 – Opt. General Notes

- Shop Dwgs for non-stressed products (default is for no drawings)
- Air Entraining (default does not require air)
- Additional testing (permeability,...)
- Modify surface finish and tolerances
- Waive laboratory requirements (default requires labs for major prestress members)



**Item 425 – Precast Prestressed Concrete Structural Members**

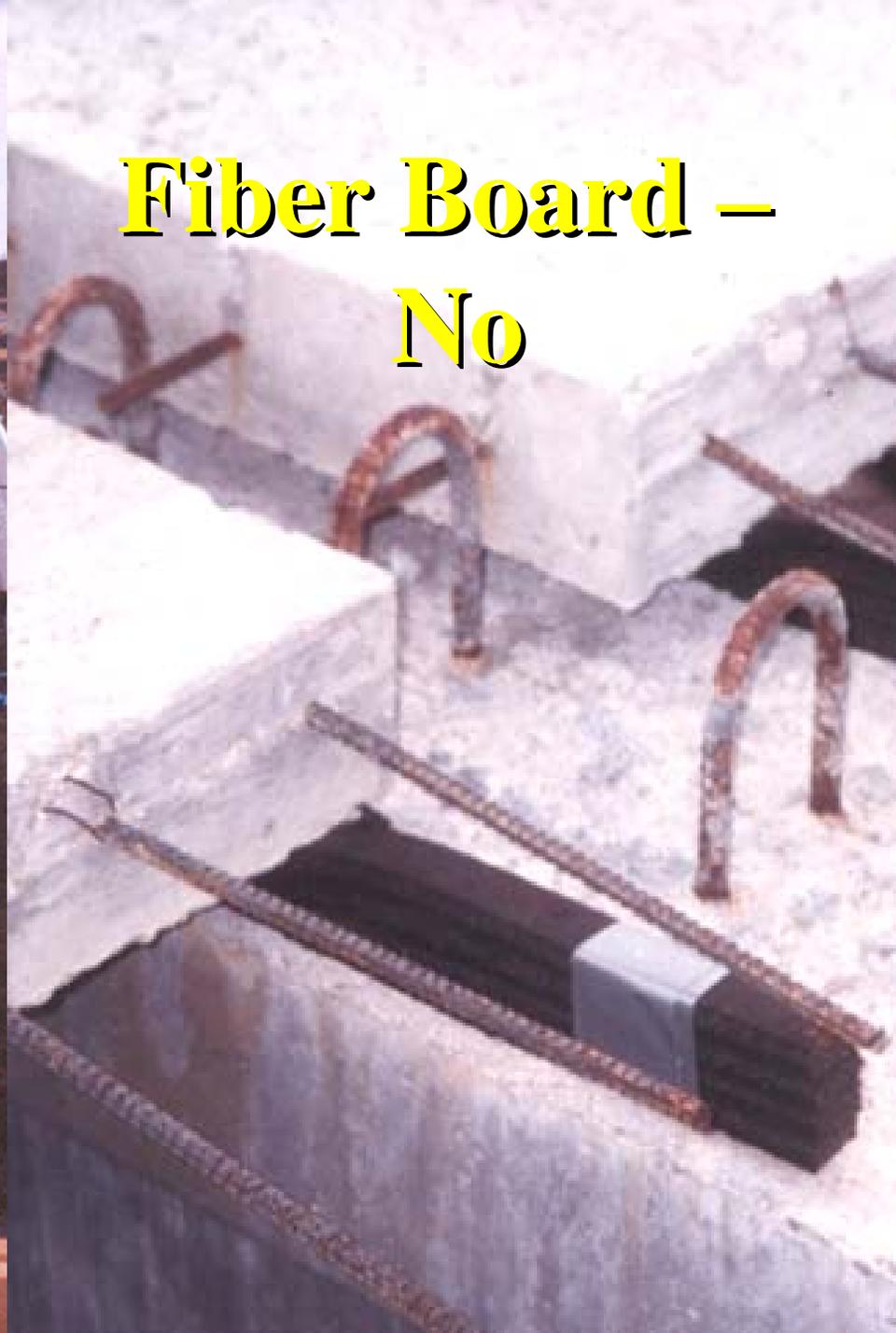
# Item 425

- Pay Item to be used for prestressed members (beams,...)
- Requires foam to be used for deck panel supports – the fiber board is no longer allowed

**Foam - Yes**



**Fiber Board - No**



# Item 426 - Prestressing



# Item 426 - Prestressing

- Incorporates most recent SP's to the 93 version
- Requires preapproved prepackaged grouts in DMS - 4670 (p. 575)
- Requires ASBI Certified Grouting personnel (p. 584)
- Revised grouting procedures as well as corrosion protection measures for tendons (new duct material, plastic grout caps,...)
- Now good for segmental bridges



# Item 426 – General Notes

## Required Note:

- All tendons are to be grouted/ungouted

## Optional notes:

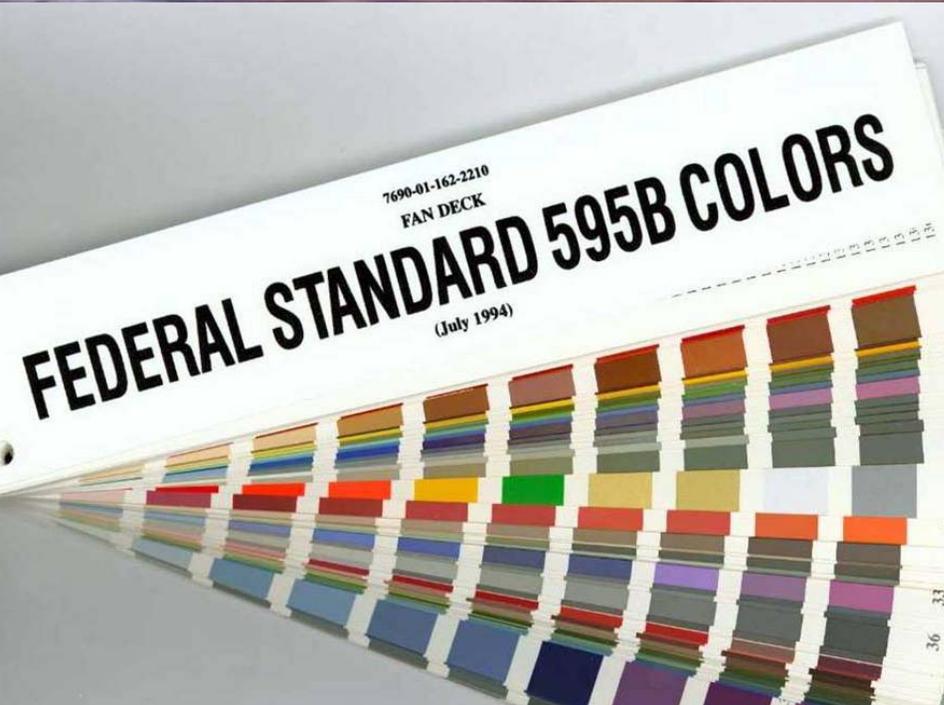
- Perform an “In-place Friction Test”
- Perform a “Duct Connection Pressure Field Test”
- Perform a “Bench Test”
- P/T is not paid for directly [segmental bridges]

# Item 427 – Surface Finishes For Concrete



# Item 427 – Surface Finishes for Concrete

- Use for higher order finishes – ordinary surface finish moved to Item 420
- No classes of finish – finishes are named
- Coatings: Adhesive grout and concrete paint; Opaque Sealer; 742 (Gray) appearance coat; Epoxy paint. (p. 593)
- Special Finishes: Blast Finish; Rub Finish; Off-the-form Finish; Form Liner Finish, Exposed Aggregate Finish (pp. 597-600)



# Item 427

- Can be set up as a pay item (sf, plan qty)

## General Notes:

- List the elements and the desired finish or color

# Item 428 – Concrete Surface Treatment

- Two classes of treatments:
  - I: Linseed Oil
  - II: Penetrating Sealer (Silane)
- Paint option moved to Item 427
- No in-place testing requirements

Required General Note: specify class of treatment

# Item 429 – Concrete Structure Repair



# Item 429 – Concrete Structure Repair

- Allows for “off-the shelf” repair products listed in an MPL by category (p. 603)
- More detailed concrete removal requirements – must chip behind exposed rebar (p. 605, 606)
- Added hydro-demolition as a removal method
- Follows practices recommended by ACI & ICRI for concrete repair

# Item 429 – General Notes

- Can limit choices of repair materials
- Indicate if Epoxy Injection is to be performed per Item 780

# Item 431 – Pneumatically Placed Concrete



# Item 431 – Pneumatically Placed Concrete

- Nozzlemen must be certified by ACI for the process (dry or wet mix) and the application (vertical or overhead) (p. 613)
- Maximum velocity for spray eqpt is 100 fps (p. 613)
- Nozzlemen certification requirements do not apply to soil nail walls (p. 613)
- 2 Bid items: Encasement (SF) or Repair (CF)

# Item 432 - Riprap



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# Item 432 - Riprap

- Added Stone Riprap (Protection) per the current SP
- Minimum rebar is specified (p. 619)

# Item 432 – General Notes

## Required:

- Provide *Type/Grade* aggregate for cement stabilized riprap (per Item 247)

## Optional

- Provide Class      Concrete (B is default)
- Provide Class      Concrete for pneumatically placed riprap (II is default)
- Stone riprap may be artificial stone (natural is default)
- Grout is required for stone riprap (dry stack is default)



Item 434 – Elastomeric Bridge Bearings

# Item 434 – Elastomeric Bridge Bearings

- Combined Items 434 and 435 from the 93 Specs to cover bearings for P/S beams and sliding bearings for steel beams.
- Also includes bearings with special components (guides,...)
- Only covers bearings – waterstops are now in Item 420

# Item 434 – Elastomeric Bridge Bearings

- Plain or laminated neoprene bearings are subsidiary to the beams for new construction and by the each for replacement
- Sliding elastomeric bearings (for steel units) are measured and paid for each bearing



Item 439 – Concrete Bridge  
Deck Overlays

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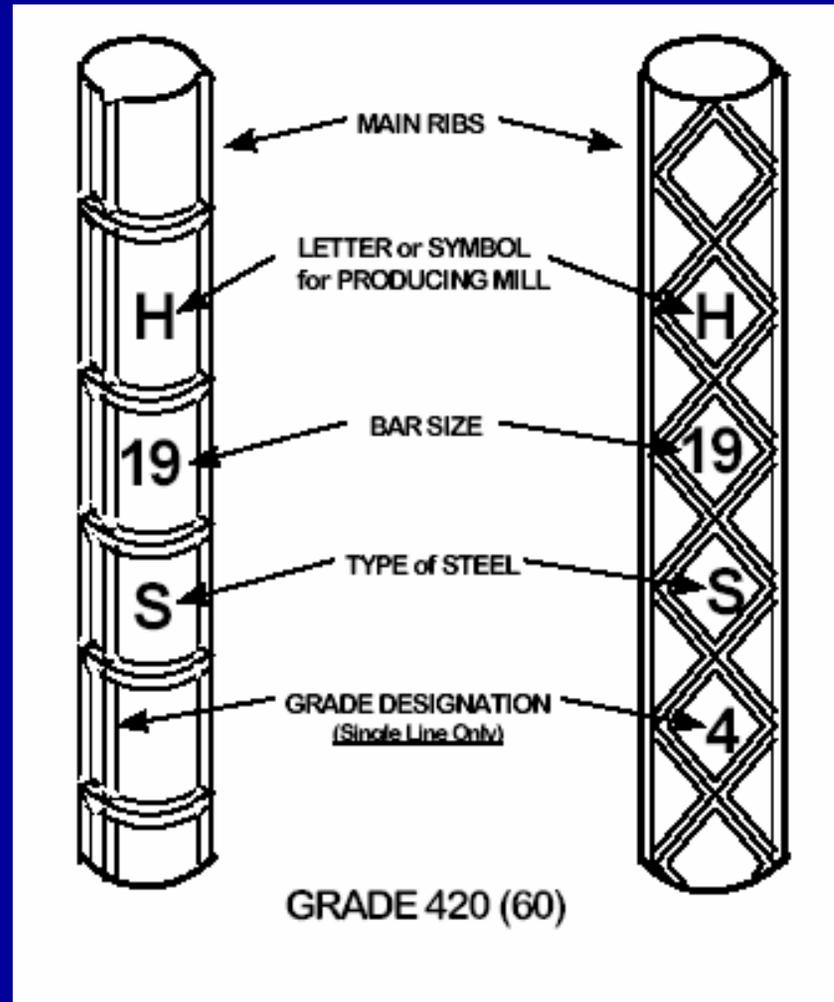
# Item 439 – Concrete Bridge Deck Overlays

- Three types of overlay concrete:
  1. Concrete (normal)
  2. Dense Concrete
  3. Latex-modified
- Can be used for partial (Type 1) or full depth (Type 2) repairs to bridge slabs as well as an overlay

# Item 439 – Optional Gen. Notes

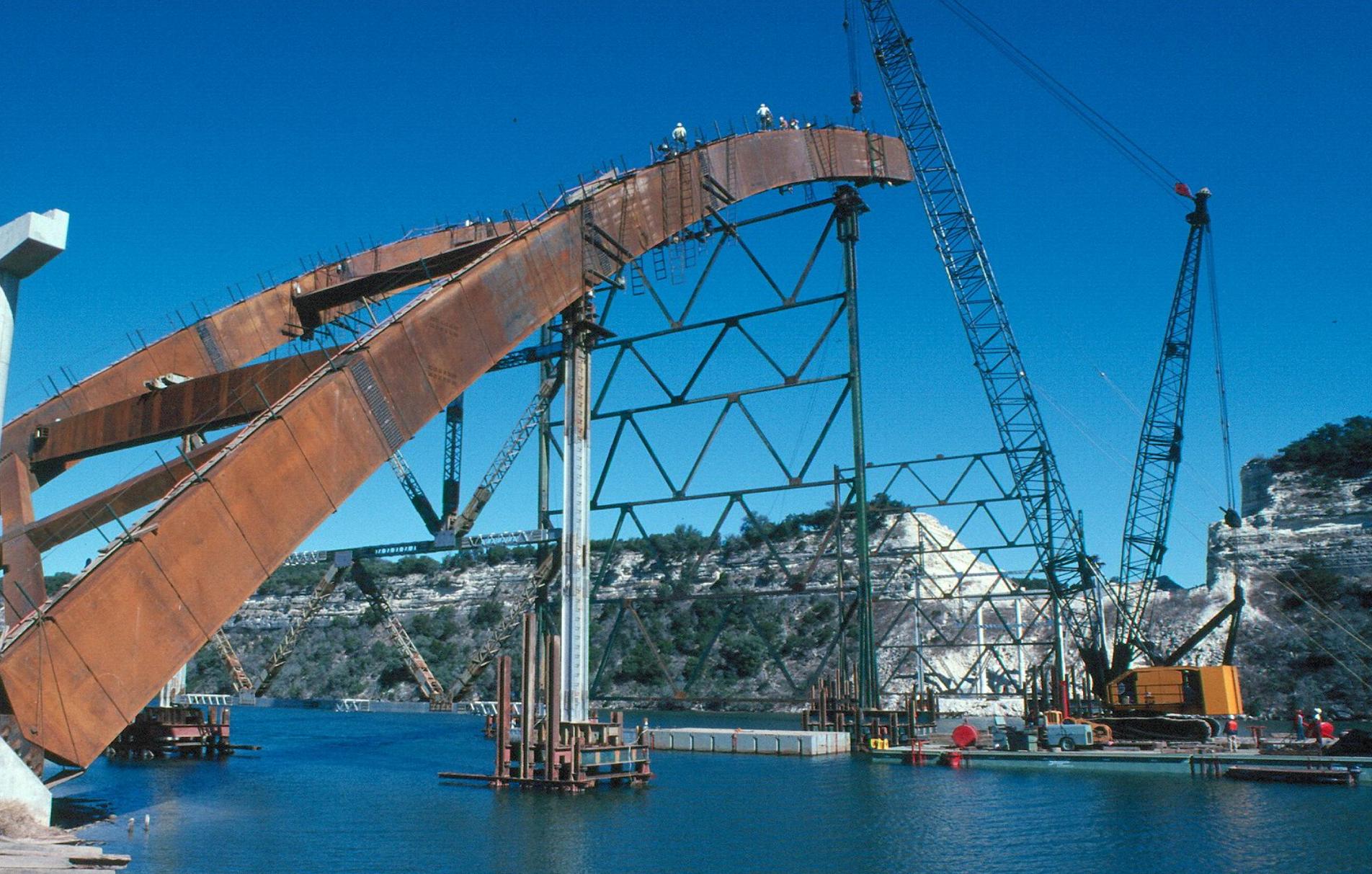
- Type \_ Cement may be used. [*default is Type I, II or I/II*]
- Provide a Grade \_ coarse aggregate for concrete or dense concrete overlays. [*6 is default*]
- Provide a Grade \_ coarse aggregate for latex-modified concrete overlays. [*8 is default*]
- Provide a cement grout bonding agent. [*default is for no bonding agent*]

# Item 440 – Reinforcing Steel



# Item 440 – Reinforcing Steel

- Updated ASTM & DMS references
- Added reference to the DMS-4510 for couplers (p. 647)
- Revised the minimum lap splice lengths (Table 5 on p. 650)
- Updated the fabrication, handling, storage, placement and repair for epoxy-coated rebar



Item 441 – Steel Structures

# Item 441

- Incorporated AASHTO/NSBA S2.1 for fabrication
- Erection Plans required to be submitted but approval is not required (p. 655)



# **“I-70 Bridge Collapse Kills 3 in SUV”**



**Denver Post – May 16, 2004**

# Item 441

- Optional General Notes:
  - Submit erection drawings for rolled-beam units (default doesn't require them)
  - List of stress-relieved items

# Item 442 – Metal for Structures



APR 27 2002

# Item 442

- Bid by the pound for the structure type (Rolled Beam, Plate Girder, Tub Girder, Box Girder, Misc) rather than by the grade of steel (no more HYC or HS steel)
- Weight deductions for copes, clips, bolt holes,... have been eliminated (p. 677)

# Item 442 General Notes

## Required

- Use Temperature Zone I/II for CVN Testing  
(must pick I or II)

## Optional

- Paint for aluminum or galvanized elements  
(default is for no paint)

# Item 446 – Cleaning and Painting of Steel



# Item 446 – Cleaning and Painting of Steel

- Must have SSPC (Society of Protective Coatings) certification for cleaning and/or painting (p. 684)
- More requirements for worker and environmental protection (p. 684)
- Revised the standard paint systems

# Item 446 – Cleaning and Painting of Steel

New paint systems (pp. 682, 683)

- I. Overcoat (replaces the System I from the 93 specs)
- II. the standard system – same as '93 but with an optional acrylic top coat
- III. same as '93
- IV. same primer as the System III but with an acrylic top coat

# Item 446 – General Notes

## Optional notes:

- Provide a System \_ Paint with a Federal Standard 595B #\_\_\_ color. *[default is System II with #742 gray appearance coat, use the Federal Standard color designation, not a color name]*

## Optional notes for repainting projects:

- The existing coating to be removed may contain lead or other hazardous materials.
- Provide a containment load analysis for wind loads

*[for large trusses]*

# Item 447 – Structural Bolting



# Item 447 – Structural Bolting

- Field R-C test is now optional to verify lubrication (p. 703)
- Field Installation Verification Test is now required (p. 704)
- Alternate fasteners have been removed
- Updated bolt installation procedures (p. 706)
- Two tensioning methods: Turn-of-the-nut and calibrated hydraulic torque wrench (p. 707)





**Item 449 – Anchor Bolts**

# Item 449 – Anchor Bolts

- New anchor bolt tightening procedures (pp. 731-733) – 1/6 of a turn using a slug wrench or cheater pipe – use for traffic signal poles, roadway illumination poles with shoe bases, high mast poles, and overhead sign supports

# Item 454 – Bridge Expansion Joints

JUN 3 2004

# Item 454 – Bridge Expansion Joints

- Covers most joint types: sealed, armor joints, header-type joints,...
- Armor joints (sealed or unsealed) are now paid under this item (by the foot) instead of by the pound using 442.
- Finger joints and asphalt plug joints will still have to use a special spec.

# Item 454 – Bridge Expansion Joints

## General Notes

- For header-type joints, use the preapproved list maintained by BRG

## Bid Codes:

- Sealed Expansion Joints            LF
- Armor Joint                            LF
- Armor Joint (Sealed)                LF
- Header-type Expansion Joint        LF or CF of  
header plus LF of seal

# Item 459 – Gabions and Gabion Mattresses



# Item 459 – Gabions and Gabion Mattresses

- New item based on SS 5014
- Payment Description:
  - Gabion Mattresses (thickness specified) (specify basket-wire coating) SY units
  - Gabion Mattresses (specify basket-wire coating) CY units
  - Gabions (specify basket-wire coating) CY units

# Item 460 – Corrugated Metal Pipe



# Item 460 – Corrugated Metal Pipe

- Added spiral rib pipe, circular and arch (see Table 2, p. 752)
  - has improved flow characteristics



# Item 460 – Corrugated Metal Pipe

- Added bell and spigot as jointing option (p. 758)
- Removed requirement that cement stabilized materials not contact aluminum pipe (see p. 879 in '93 specs)

# Item 462 – Concrete Box Culverts and Storm Drains



# Item 462 – Concrete Box Culverts and Storm Drains

- Changed title from “Concrete Box Culverts and Sewers”
- Fabrication:
  - CIP, Item 420
  - formed precast, Item 424
  - machine-made precast, ASTM C 1433  
(was ASTM C 789 and ASTM C 850)

# Item 464 – Reinforced Concrete Pipe

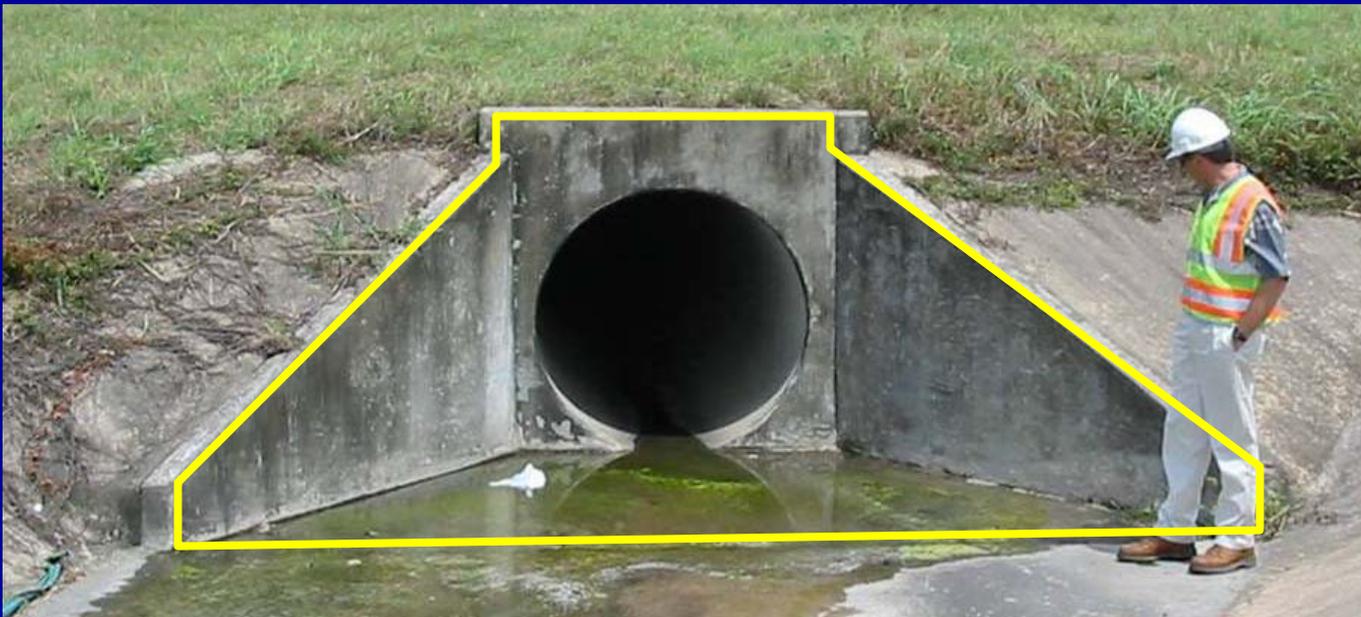
- Contractor must design pipe for jacking, boring or tunneling (p. 772)
- Fabrication sampling changed to 1 in 300 (p. 772)
  - Undamaged tested pipe may be used

# Item 466 – Headwalls and Wingwalls



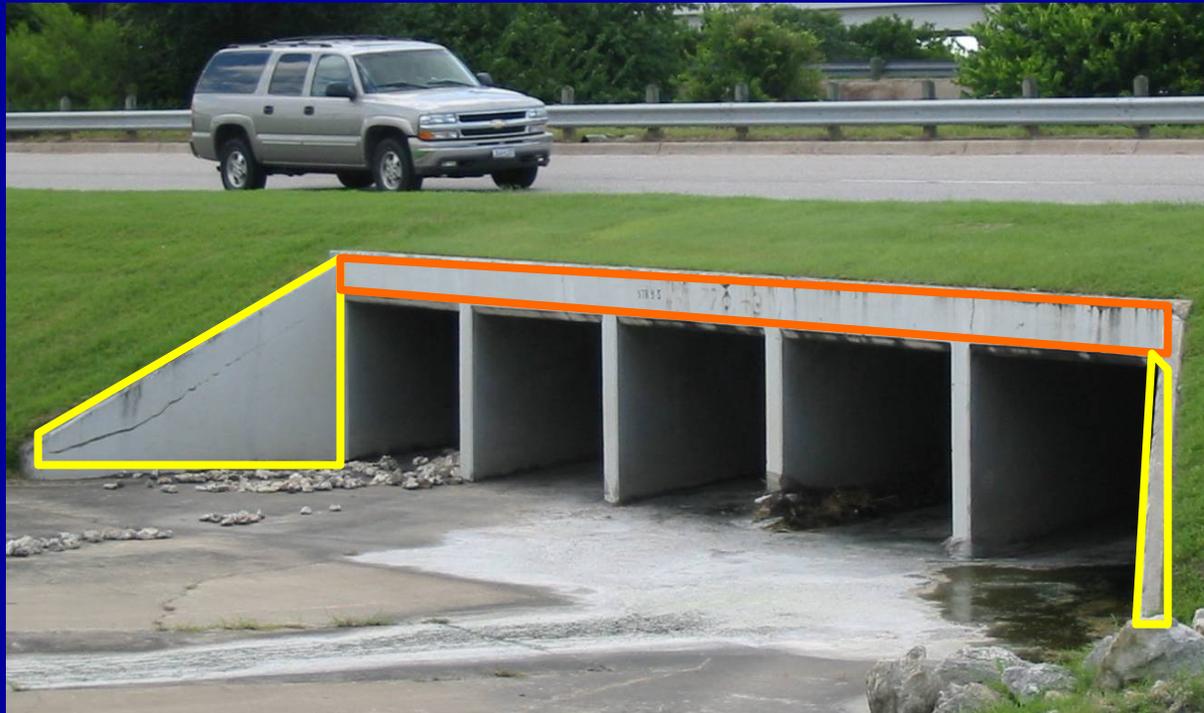
# Item 466 – Headwalls and Wingwalls

- Definition (p. 783):
  - Headwalls: all walls, including wings, at the ends of single or multiple-barrel pipe culvert structures



# Item 466 – Headwalls and Wingwalls

- Definition (p. 783):
  - Wingwalls: all walls at ends of single or multiple-barrel box culvert structures



# Item 466 – Headwalls and Wingwalls

- CIP and precast in accordance with Item 420 (p. 782)
- Class C concrete (p. 782)
- Measurement
  - Headwalls Ea
  - Wingwalls Ea, SF

# Item 467 – Safety End Treatment



# Item 467 – Safety End Treatment



SET Type I

# Item 467 – Safety End Treatment



**SET Type II**



**SET Type II Precast**

# Item 467 – Safety End Treatment

- CIP and precast in accordance with Item 420 (p. 786)
- Class C concrete for SET (p. 785)
  - Class B Concrete for riprap

# Item 467 – Safety End Treatment

- Riprap not required for precast unless shown on plans (p. 786)
- Limits of riprap to be included in price bid will be shown on plans (p. 788)
  - riprap beyond limits shown, paid for in accordance with Item 432

# Item 467 – Safety End Treatment

- Payment Description:
  - SET (Type 1) (Barrel Span) (Wall Ht) (Slope, Horiz:Vert) (Orientation, Cross or Parallel)
  - SET (Type 1) (Pipe dia or Design) (Slope, Horiz:Vert) (Orientation, Cross or Parallel)
  - SET (Type II) (Pipe dia or Design) (Pipe mat'1) (Slope, Horiz:Vert) (Orientation, Cross or Parallel)

# Item 495 – Raising Existing Structures



# Item 495 – Raising Existing Structures

- Establishes falsework design criteria (p.808)
  - deadload only
  - deadload + liveload
- Clarifies span lifting limits (p. 808)
  - simple spans
  - simple spans with continuous deck
  - continuous beams

# Item 496 – Removing Structures

- Changed title from “Removing Old Structures”
- Bid Codes - REMOV STR
  - (BOX CULVERT) EA
  - (INLET) EA
  - (MANHOLE) EA
  - (SET) EA
  - (WINGWALL) EA
  - (HEADWALL) EA
  - (PIPE) LF
  - (BOX CULVERT) LF

# Item 496 – Removing Structures

- Bid Codes - REMOV STR
  - (BRIDGE 0 - 99 FT LENGTH) EA
  - (BRIDGE 100 - 499 FT LENGTH) EA
  - (BRIDGE 500 - 999 FT LENGTH) EA
  - (BRIDGE 1000 FT OR GREATER) EA

# Item 496 – General Notes

- No required General Notes
- Optional General Notes:
  - Structural steel coating may contain hazardous materials

# Item 499 – Adjusting Steel Shoes



# Item 499 – Adjusting Steel Shoes

- New item based on SS 4007
- For adjustment and repair of existing steel shoes
- Includes:
  - trimming beam ends
  - cleaning and painting
- Must set up Item 429 for spall repair (p. 811)

# Deleted '93 Specs

- **Item 433, “Joint Sealants and Fillers”**
  - **changed to DMS-6310, “Joint Sealants and Fillers”**

# Deleted '93 Specs

- **Item 435, “Elastomeric Materials”**
  - moved into Item 434, “Elastomeric Bridge Bearings”
  - waterstops referenced in Item 420  
now DMS-6160, “Waterstops, Nylon Reinforced Neoprene Sheet, and Elastomeric Pads”

# Deleted '93 Specs

- **Item 437, “Concrete Admixtures”**
  - **changed to DMS-4640, “Chemical Admixtures for Concrete”**

# Deleted '93 Specs

- **Item 443, “Permanent Metal Deck Forms”**
  - requirements shown on “new” standard –  
**PMDF**

# Deleted '93 Specs

- **Item 444, “Bridge Protective Assembly”**
  - requirements shown on “new” standards
    - **Bridge Protective Assembly (BPA)**
    - **Bridge Mounted Clearance Sign (BMCS)**
  - **BPA paid under Item 442**
  - **BMCS paid under Item 636**

# Deleted '93 Specs

- **Item 485, “Wet Sandblasting”**  
– moved into Item 439

# Deleted '93 Specs

- **Item 498, “Plant Inspection Laboratory (Equipped)”**
  - **moved into Item 504, Item 424, DMS-7300**

# Deleted '93 Specs

- **Item 534, “Structure Approach Slabs”**
  - requirements shown on “new” bridge standards
    - **BAS-A**
    - **BAS-C**
  - **construct and pay under Item 420**



**Thank You!**