Session 9

Tom Andres

FDOT Central Office Structures Design

Graves Avenue Bridge over I-4: How-To Manual

Topic Description

Possible implementation Self Propelled Modular Transporters (SPMT's) strategies on future FDOT projects.

Speaker Biography

BSCE University of Florida
20 years experience with the Florida Department of Transportation. Currently Area Engineer for Districts 4, 7 and Turnpike.

Self-Propelled Modular Transporters (SPMT)

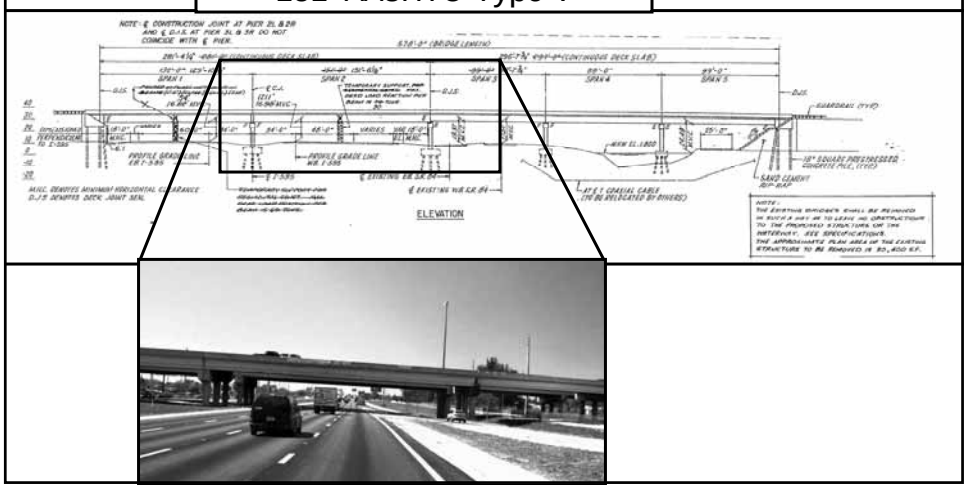
Possible Future Strategies

Possible SPMT Future Strategies

- Strategy 1: Composite Dead Load Designs
- Strategy 2: Span Reuse Concepts

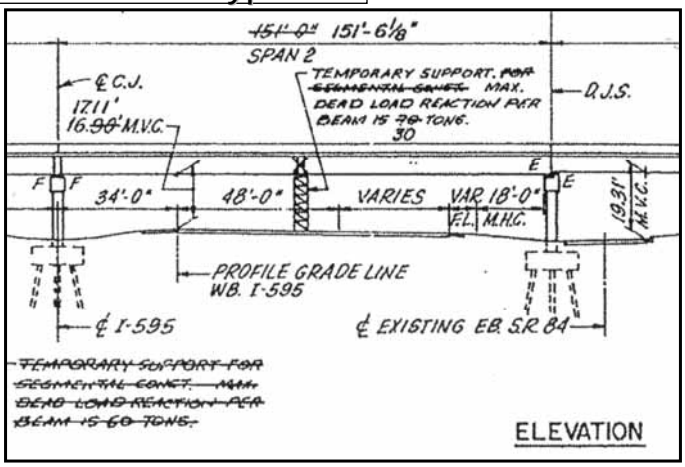
SPMT: Strategy 1 – Composite Dead Load Designs

Turnpike Over I-595
151' AASHTO Type V



SPMT: Strategy 1 – Composite Dead Load Designs

Turnpike Over I-595
151' AASHTO Type V



Strategy 1 – Composite Dead Load Designs

TEMPORARY SUPPORT FOR SPAN 2 ERECTION:

1. ELEVATIONS OF THE BOTTOM OF ALL BEAMS AT TEMPORARY SUPPORT LOCATIONS SHALL BE MONITORED AND MAINTAINED BY THE CONTRACTOR. FLAT JACKS OR SCREW JACKS SHALL BE PLACED UNDER BEAMS TO PROVIDE FOR ELEVATION ADJUSTMENT DURING CONCRETE PLACEMENT OPERATIONS. SUPPORTS SHALL NOT BE REMOVED UNTIL ALL DECK CONCRETE HAS BEEN PLACED IN SPAN 2, CURED A MINIMUM OF 14 DAYS AND HAS REACHED 4000 PSI COMPRESSIVE STRENGTH.

2. THE CONTRACTOR SHALL SUBMIT SHOP DRAWINGS OF TEMPORARY SUPPORT SYSTEM FOR APPROVAL, SHOWING METHOD OF ADJUSTING SUPPORTS.

3. THE CONTRACTOR SHALL MONITOR THE ELEVATION OF THE BOTTOM OF ALL BEAMS IN SPAN 2 TO AN ACCURACY OF ± ONE HUNDREDTH OF A FOOT, AS FOLLOWS:

   A. RECORD ELEVATION AT .25L, .5L (TEMPORARY SUPPORT), AND .75L OF EACH BEAM AS SOON AS PRACTICAL AFTER ALL BEAM ERECTION IS COMPLETED IN SPAN 2

   B. RECORD ELEVATION AT .5L WITHIN 24 HRS. PRIOR TO PLACING MIDSPAN DIAPHRAGM CONCRETE AND AGAIN WITHIN 24 HRS. BEFORE PLACING DECK CONCRETE IN SPAN 2. IN EITHER CASE SUPPORT ELEVATION SHALL BE ADJUSTED TO WITHIN .02 FOOT OF THE INITIAL ELEVATION RECORDED IN (A.), PRIOR TO PLACING CONCRETE.

   C. ELEVATIONS AT .5L WILL BE MONITORED PERIODICALLY DURING PLACEMENT OF CONCRETE IN SPAN 2. THE TIME PERIOD BETWEEN ELEVATION CHECKS SHALL NOT EXCEED 2 HOURS WHILE CONCRETE IS BEING PLACED. ADDITIONAL CHECKS MAY BE REQUIRED BY THE ENGINEER TO VERIFY THAT SUPPORT ELEVATIONS ARE WITHIN TOLERANCE. SUPPORT ELEVATIONS WILL BE ADJUSTED AS NECESSARY TO LIMIT DEVIATION FROM THE INITIAL RECORDED ELEVATION (A.) TO .04 FOOT MAXIMUM.

   D. RECORD ELEVATIONS AT .25L, .5L AND .75L PRIOR TO REMOVAL OF TEMPORARY SUPPORT FOR EITHER OF TWO CONDITIONS:

      1) PRIOR TO STARTING REMOVAL OF DECK FORMS
      2) AFTER REMOVAL OF ALL DECK FORMS IN SPAN 2.

   E. RECORD ELEVATIONS AT .25L, .5L AND .75L AFTER REMOVAL OF TEMPORARY SUPPORT AND DECK STRIPPING IS COMPLETED.

   F. RECORD DECK P.G.L AND GUTTER ELEVATIONS AT POINTS OF SPAN 2 CORRESPONDING TO LOCATIONS SHOWN ON CONSTRUCTION DATA DRAWINGS BEFORE AND AFTER THE TEMPORARY SUPPORTS ARE REMOVED.

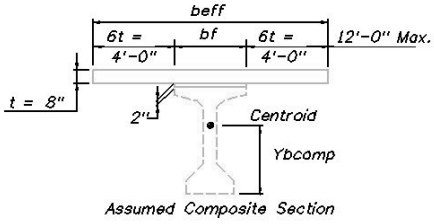
   G. FOR CONSTRUCTION SEQUENCE OF SPANS 1 AND 2, SEE SHEET B-32.

   H. ELEVATIONS TAKEN AT BOTTOM OF BEAM AT LOCATION .5L SHALL BE OBTAINED AT CONSISTENT LOCATION NEAR POINT OF TEMPORARY SUPPORT. ALL REFERENCE ELEVATION POINTS SHALL BE FIELD MARKED FOR IDENTIFICATION PURPOSES.

SPMT: Strategy 1 – Composite Dead Load Designs

Example - Possible Benefits

Assume:
- *8" slab*
- *2" Build- up*
- *Max. Beam Spacing 12'-0"*
- *f'cbeam = 6500 psi*
- *f'cslab = 4500 psi*
- *DL to LL Ratio = 2.0 (2.0/ 0.8 = 2.5 for Service Level III due to 0.8 load factor on LL)*
- *Non -transformed Sections*
- *Superimposed Dead Loads Neglected*



$$\%Diff := \frac{(\sigma_2 - \sigma_1)}{\sigma_1} \cdot 100 \qquad \%Diff := \left(\frac{\sigma_2}{\sigma_1} - 1\right) \cdot 100$$

$$\sigma_2 := \frac{M_{LL}}{S_{bc}} + \frac{M_{DL}}{S_b} \qquad \sigma_1 := \frac{M_{LL} + M_{DL}}{S_{bc}}$$

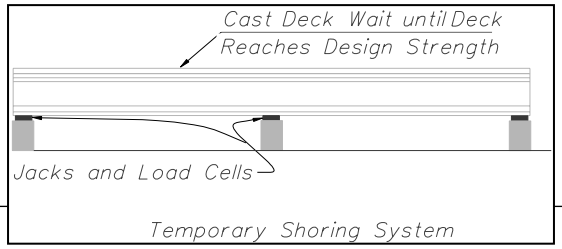
$$\frac{\sigma_2}{\sigma_1} := \frac{\left(\frac{M_{LL}}{S_{bc}} + \frac{M_{DL}}{S_b}\right)}{\frac{M_{LL}+M_{DL}}{S_{bc}}} \qquad \frac{\sigma_2}{\sigma_1} := \frac{\left(M_{LL} + M_{DL} \cdot \frac{S_{bc}}{S_b}\right)}{(M_{LL} + M_{DL})}$$

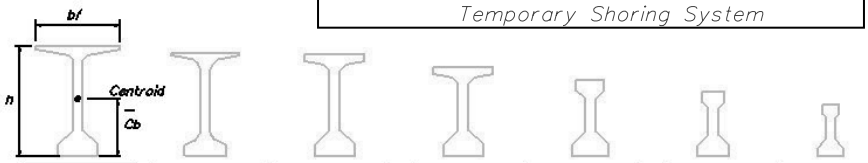
$$\frac{\sigma_2}{\sigma_1} := \frac{\left(1 + \frac{M_{DL}}{M_{LL}} \cdot \frac{S_{bc}}{S_b}\right)}{1 + \frac{M_{DL}}{M_{LL}}}$$

Tension at Bottom of Beam

$$\%Diff := \left[\frac{\left(1 + \frac{M_{DL}}{M_{LL}} \cdot \frac{S_{bc}}{S_b}\right)}{1 + \frac{M_{DL}}{M_{LL}}} - 1\right] \cdot 100$$

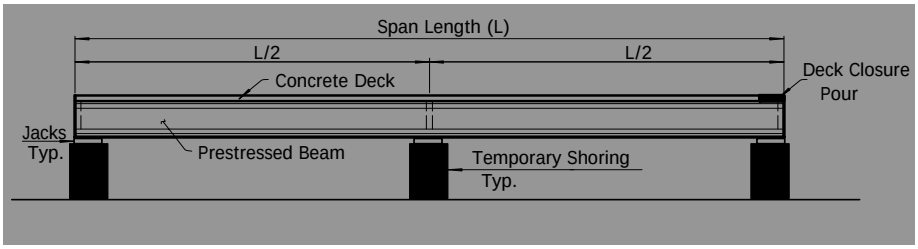
SPMT: Strategy 1 – Composite Dead Load Designs





	FBT 78	FBT 72	Type VI	Type V	Type IV	Type III	Type II
	bf=60 in h=78 in I=934,838 in^4 A=1,104 in^2 Cb=40.41 in	bf=48 in h=72 in I=639,980 in^4 A=901 in^2 Cb=34.38 in	bf=42 in h=72 in I=733,320 in^4 A=1,085 in^2 Cb=36.38 in	bf=42 in h=63 in I=521,180 in^4 A=1,013 in^2 Cb=31.98 in	bf=20 in h=54 in I=260,741 in^4 A=789 in^2 Cb=24.73 in	bf=16 in h=45 in I=125,390 in^4 A=560 in^2 Cb=20.27 in	bf =12 in h=36 in I=50,979 in^4 A=369 in^2 Cb=15.83 in
n Sbc/Sb	Sb= 23,129 in^3 Sbc=31,564 in^3	Sb= 18,815 in^3 Sbc=26,888 in^3	Sb= 20,157 in^3 Sbc=28,852 in^3	Sb= 16,307 in^3 Sbc=23,948 in^3	Sb= 10,544 in^3 Sbc=17,794 in^3	Sb= 6,186 in^3 Sbc=11,408 in^3	Sb= 3,220 in^3 Sbc=6,697 in^3
	1.36	1.44	1.43	1.47	1.69	1.84	2.08
% Diff.	26 %	32 %	31 %	33 %	49 %	60 %	77 %

SPMT: Strategy 1 – Composite Dead Load Designs



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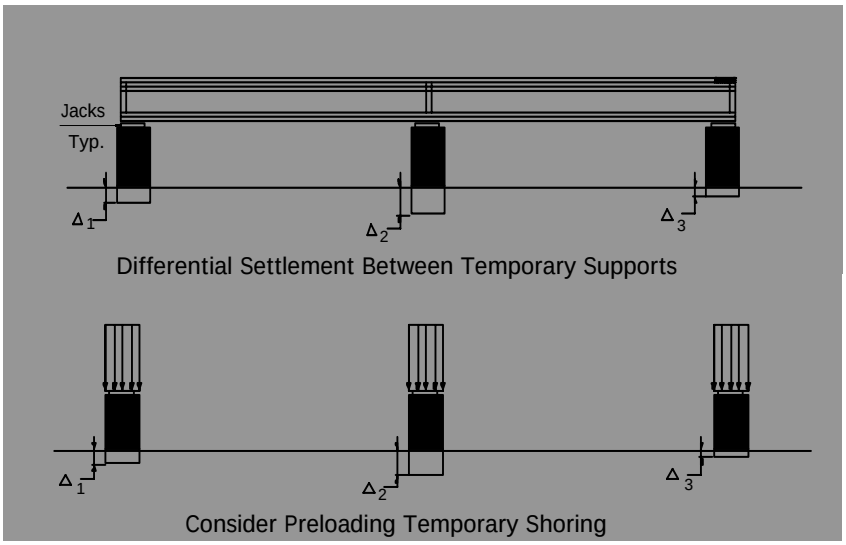


SPMT: Strategy 1 – Composite Dead Load Designs

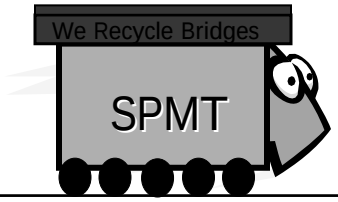
Considerations:

- **Beam Stability**
  - **Off-site Fabrication vs On-site**
  - **Temporary Bracing**
- **Temporary Supports**
  - **Geometry Control**
  - **Differential Settlement**
- **Shear Requirements May Govern**
- **Site Access Issues**

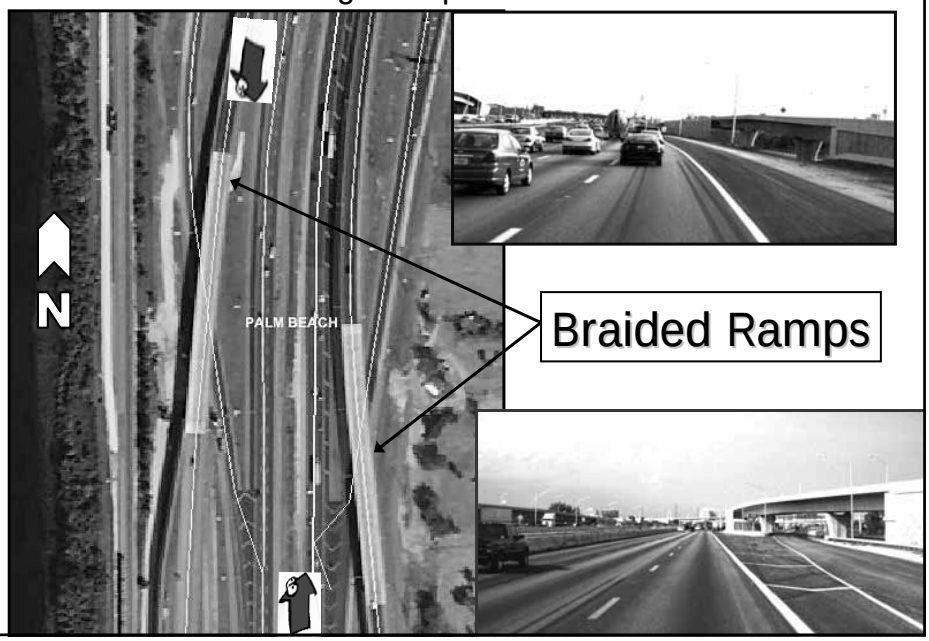
SPMT: Strategy 2 – Span Reuse Concepts

Florida is Predicted to Replace New York as the Third Largest State by 2030.

Urban Bridges in Florida are Replaced Based on Highway Capacity Needs Well Before They Have Reached Their Useful Life.



SPMT: Strategy 2 – Span Reuse Concepts
Interstate Widening Example



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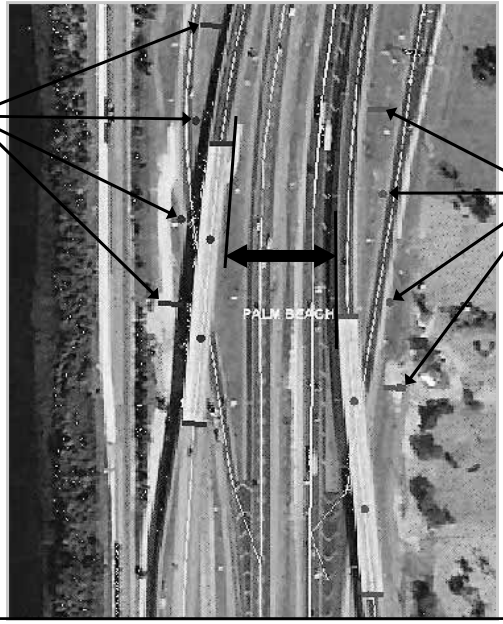
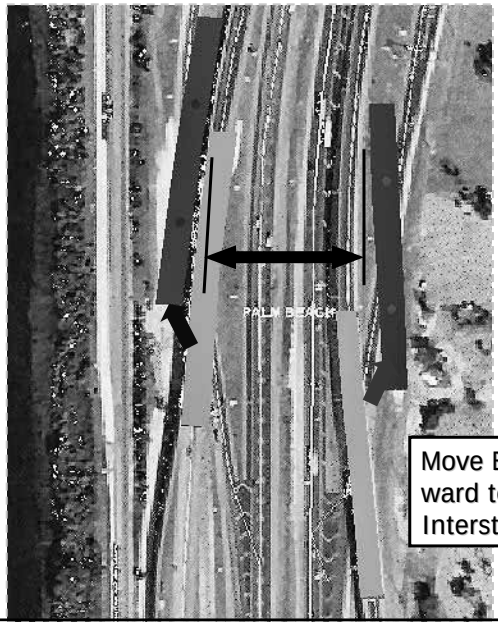
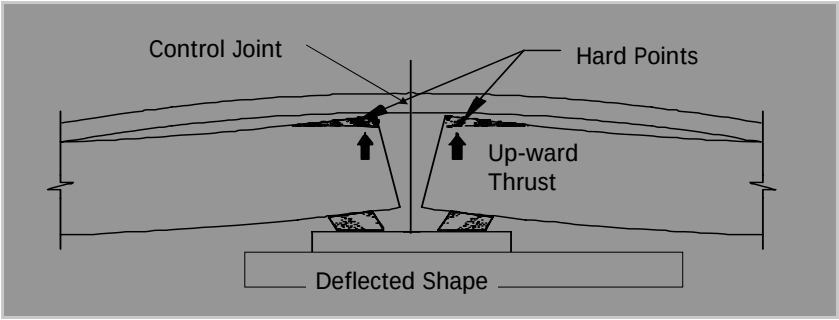


SPMT: Strategy 2 – Span Reuse Concepts
Interstate Widening Example



SPMT: Closure Pour & Diaphragm Details



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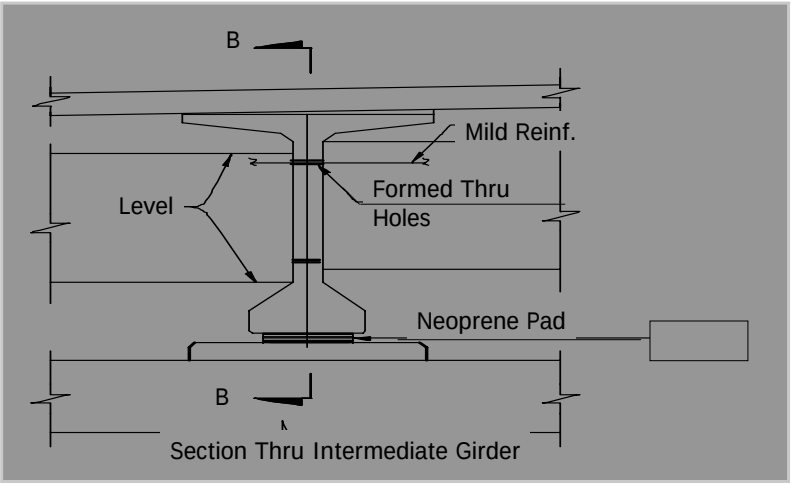

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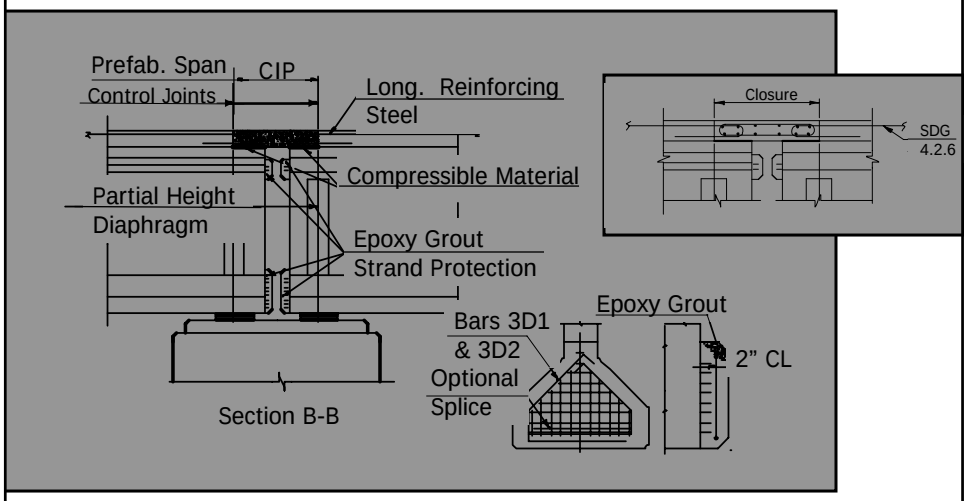

Future I-4 Widening Project

- **Incentive – Disincentive (I/D) to Reduce Construction Time and Traffic Impacts**
  - **Cassadaga Road**
    - **I/D $7,500/day up to $150,000 max.**
    - **Bonus - $200,000**
  - **Total Project Completion**
    - **I/D $15,500/day up to $2,000,000 max.**
- **SPMT Contractor Alternates**
  - **Span Installation Plan**
  - **Composite Dead Load Design**

SPMT- Another Useful Tool in the Toolbox

SPMT: Questions