AAC
ASOCIACIÓN ARGENTINA DE CARRETERAS

CICLO DE
SEMINARIOS WEB

Diseño, construcción y montaje de viaductos ferroviarios y viales.

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CONSIDERACIONES SOBRE EL DISEÑO ESTRUCTURAL

ELEGIDA LA OPCIÓN DE REALIZAR UN VIADUCTO POR SOBRE OTRAS ALTERNATIVAS POSIBLES, EL DISEÑO ESTRUCTURAL ESTARÁ PRINCIPALMENTE REGIDO POR:

- **ANÁLISIS DE LAS VENTAJAS Y DESVENTAJAS DE SISTEMAS PREOMOLDEADOS vs. IN SITU**
- **DISPONIBILIDAD DE LUGAR PARA LA INSTALACIÓN DE PLANTA DE PREMOLDEADOS**
- **DIFICULTAD EN EL TRANSPORTE DE PREMOLDEADOS**
- **CANTIDAD DE VÍAS O ANCHO DE CALZADA Y GEOMETRÍA DE LA TRAZA**
- **DISPONIBILIDAD Y ACCESIBILIDAD DE EQUIPOS DE MONTAJE**
- **LUGAR DE IMPLANTACIÓN DE LA OBRA (ZONA URBANA, CRUCE FLUVIAL, ZONA MONTAÑOSA, ETC.)**

INFRAESTRUCTURA – PILAS Y FUNDACIONES

- MONOPILAS (COLUMNA CIRCULAR, RECTANGULAR, “HIPÓDROMO” Y CAPITEL)
- PÓRTICOS CONFORMADOS POR VIGA DINTEL (HA o HP) Y DOS O MAS COLUMNAS
- FUNDACIONES MEDIANTE MONOPILOTES O CABEZAL DE PILOTES
- ESTRIBOS CERRADOS O ABIERTOS (INTEGRALES, SEMI-INTEGRALES O SIMPLES)

SUPERESTRUCTURA

- LUCES ENTRE 30 A 110 M (PREMOLDEADO) Y ENTRE 70 A 300 M (IN SITU) DEPENDIENDO DE:
  - SISTEMA ESTRUCTURAL SIMPLEMENTE APOYADO O CONTINUO
  - SIST. DE MONTAJE (FULL SPAN / SPAN BY SPAN / VOLADIZOS BALANC. / EMPUJE O ARRASTRE).
  - SISTEMA DE CONSTRUCCIÓN (PREMD. 30 a 110 m o IN SITU 70 a 300 m – Hcte 30 a 60 m Hvar 70 a 300 m)
  - TIPOS Y CAPACIDAD DE EQUIPOS DE MONTAJE (EQUIPO DE LANZAMIENTO, GRÚAS, MEGALIFT, ENCOFRADOS TRANSPORTABLES, ETC.). LUCES RECOMENDADAS HASTA 60 M
  - CARACTERÍSTICAS DEL SUELO DE FUNDACIÓN
  - INTERFERENCIAS, CRUCES, ETC.

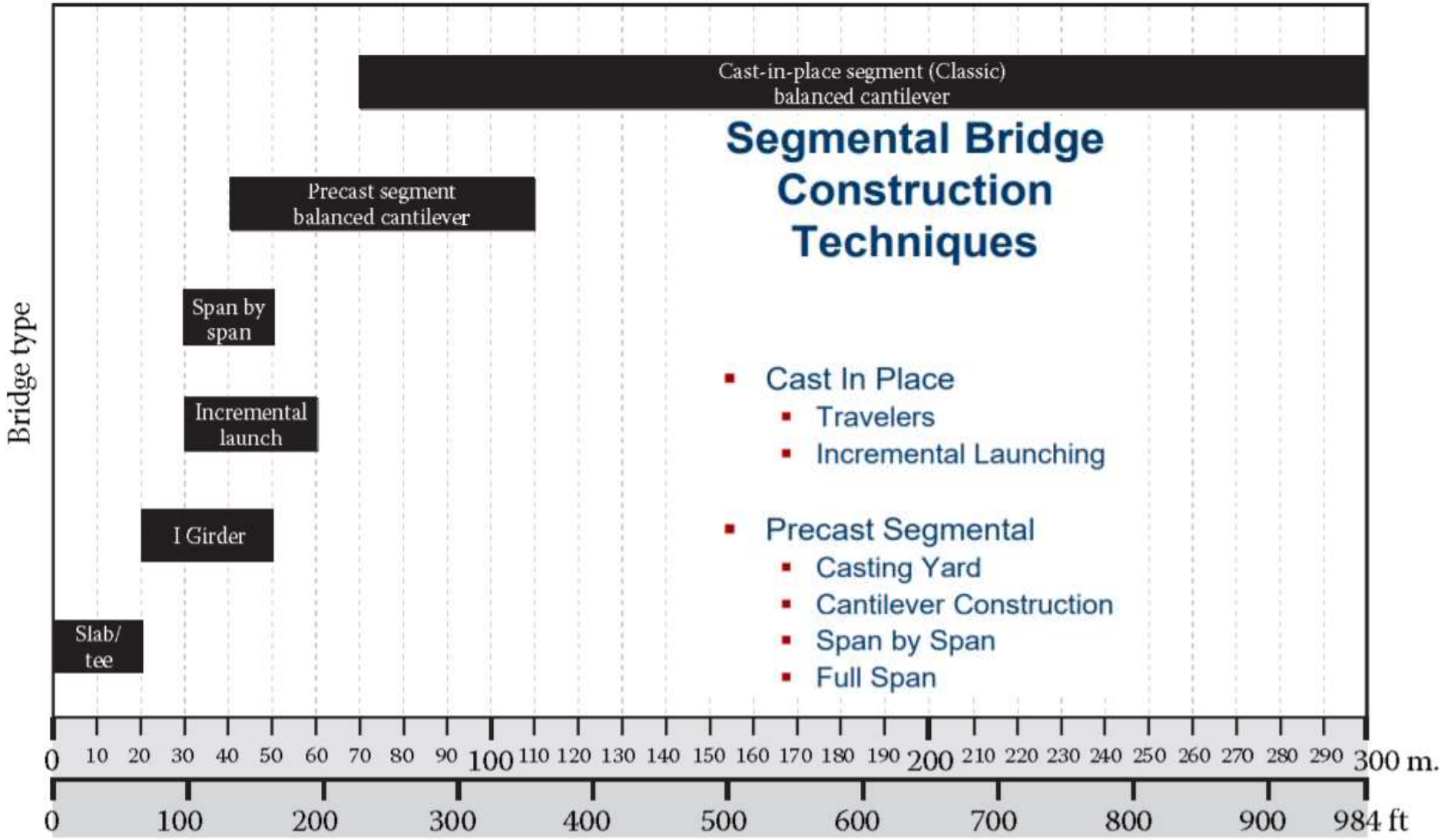
- **SECCIONES USUALES:**
  - VIGAS CAJÓN PREMOLDEADAS O IN SITU
  - VIGAS NABLA O ARTESA PREMOLDEADAS Y LOSA IN SITU
  - VIGAS NABLA O ARTESA PREMOLDEADAS Y PANELES PREMOLDEADOS DE LOSA
  - VIGAS U (UNA O DOS VÍAS) O DOBLE U / W PREMOLDEADAS O IN SITU
  - VIGAS DOBLE T o I PREMOLDEADAS Y LOSA IN SITU
  - VIGAS Z O L PREMOLDEADAS Y LOSA INFERIOR IN SITU

SUPERESTRUCTURA - MATERIALES

- **HORMIGÓN ARMADO**
  - POCO USUAL PARA LAS VIGAS DE RIGIDEZ EN LUCES HABITUALES Y/O CONVENIENTES. UTILIZADO EN LOSAS DE TABLERO (LUZ MODERADA)
  - LEVE AFECTACIÓN POR FATIGA

- **HORMIGÓN PRETENSADO O POSTESADO (INTERNO, EXTERNO O MIXTO)**
  - **USUALMENTE UTILIZADO EN VIGAS DE RIGIDEZ PARA LAS LUCES HABITUALES**
  - **POSTESADO TRANSVERSAL PARA DOS O MÁS VÍAS**
  - **LEVE AFECTACIÓN POR FATIGA**
- **ACERO**
  - **USUALMENTE UTILIZADO EN VIGAS DE RIGIDEZ. ESTRUCTURAS MAS LIVIANAS PARA IGUALDAD DE LUCES**
  - **FACILIDAD DE MONTAJE**
  - **INGENIERÍA, CONSTRUCCIÓN Y QA/QC DE MAYOR EXPERTISE**
  - **ALTA AFECTACIÓN POR FATIGA. SUELE SER DIMENSIONANTE DE ALGUNOS ELEMENTOS ESTRUCTURALES PRINCIPALES (PRINCIPALMENTE VIGAS TRASNV. Y LONG. SECUND.)**
- **MIXTO HORMIGÓN - ACERO**
  - **EN GENERAL, VENTAJAS Y DESVENTAJAS INTERMEDIAS ENTRE AMBOS CASOS**
  - **MODERADA AFECTACIÓN POR FATIGA**

LUCES CONVENIENTES PARA LOS DISTINTOS SISTEMAS DE CONSTRUCCIÓN POR SEGMENTOS



Economical span length ranges for typical concrete bridge types.

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SISTEMAS DE MONTAJE

A) MONTAJE POR SEGMENTOS PREFABRICADOS (SEGMENTACIÓN TRANSVERSAL)

Figure 10. This long twin-upper-beam gantry is used for balanced-cantilever erection. Photograph courtesy of HNTB archive.

1- MONTAJE VANO A VANO (*SPAN BY SPAN*)

30 m ≤ L ≤ 50 m

2- VOLADIZOS BALANCEADOS (*BALANCED CANTILEVER*)

40 m ≤ L ≤ 110 m

Progressive placement (Photo: Vinci)

Incremental launching (Photo: Leonhardt)

4- MONTAJE POR EMPUJE O ARRASTRE / LANZAMIENTO INCREMENTAL (*INCREMENTAL LAUNCHING*) 30 m ≤ L ≤ 60 m

3- AVANCE PROGRESIVO CON SISTEMA DE ATIRANTAMIENTO O PILAS TEMPORARIAS (*PROGRESSIVE PLACEMENT WITH CABLE-STAY SYSTEM OR TEMPORARY PIERS*) 30 m ≤ L ≤ 100 m

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B) MONTAJE A TRAMO COMPLETO *FULL SPAN* DE TRAMOS PREFABRICADOS

DIFERENTES EQUIPOS DE LANZAMIENTO

58m, 321ton carrier for placement of 31.5m, 740ton single-track HSR spans

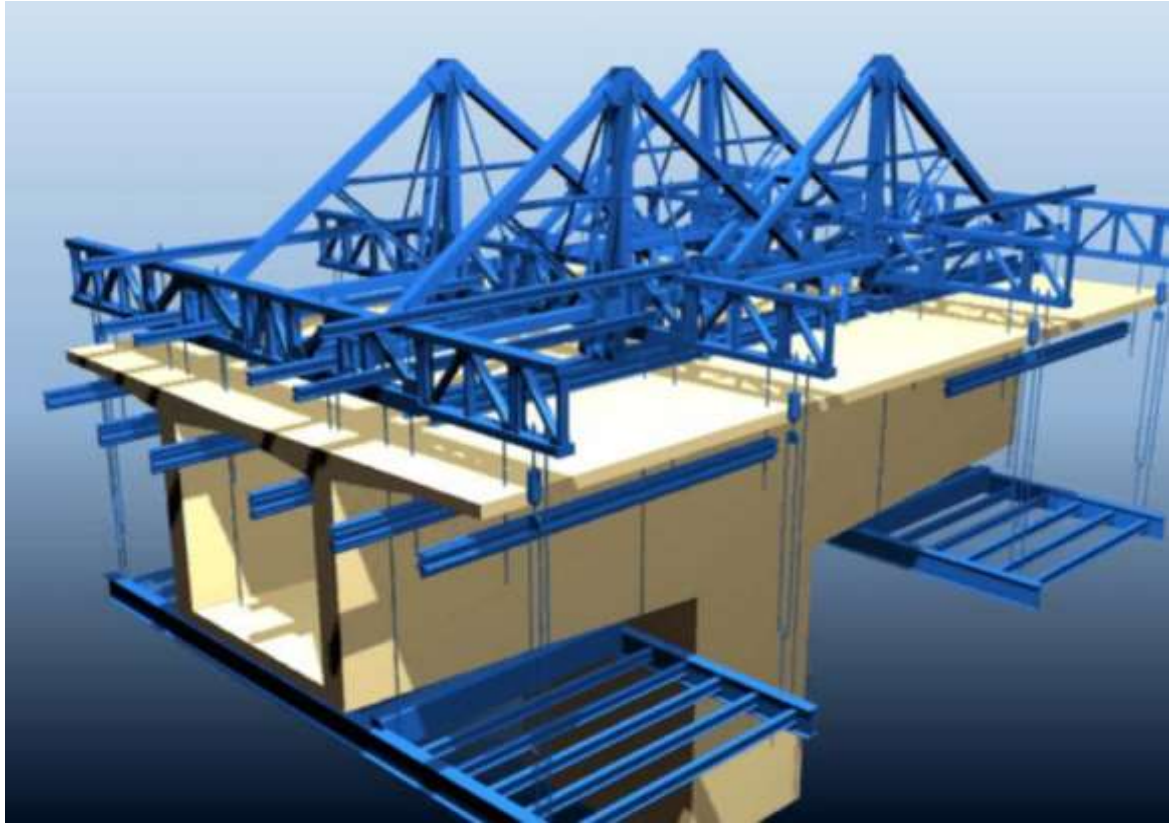
Figure 14. This wheeled span carrier has a self-launching support beam for high-speed railway projects.

Figure 10. Twin-girder 2.3-span launcher for 32.7 m (107 ft), 4000 kN (900 kip) single-track box girders. *Courtesy of BWM.*

75m, 520ton gantry with 38m, 80ton underbridge for placement of 33m, 900ton dual-track HSR spans (Beijing Wowjoint Machinery)

C) EJECUCIÓN IN SITU POR SEGMENTOS

70 m ≤ L ≤ 300 m



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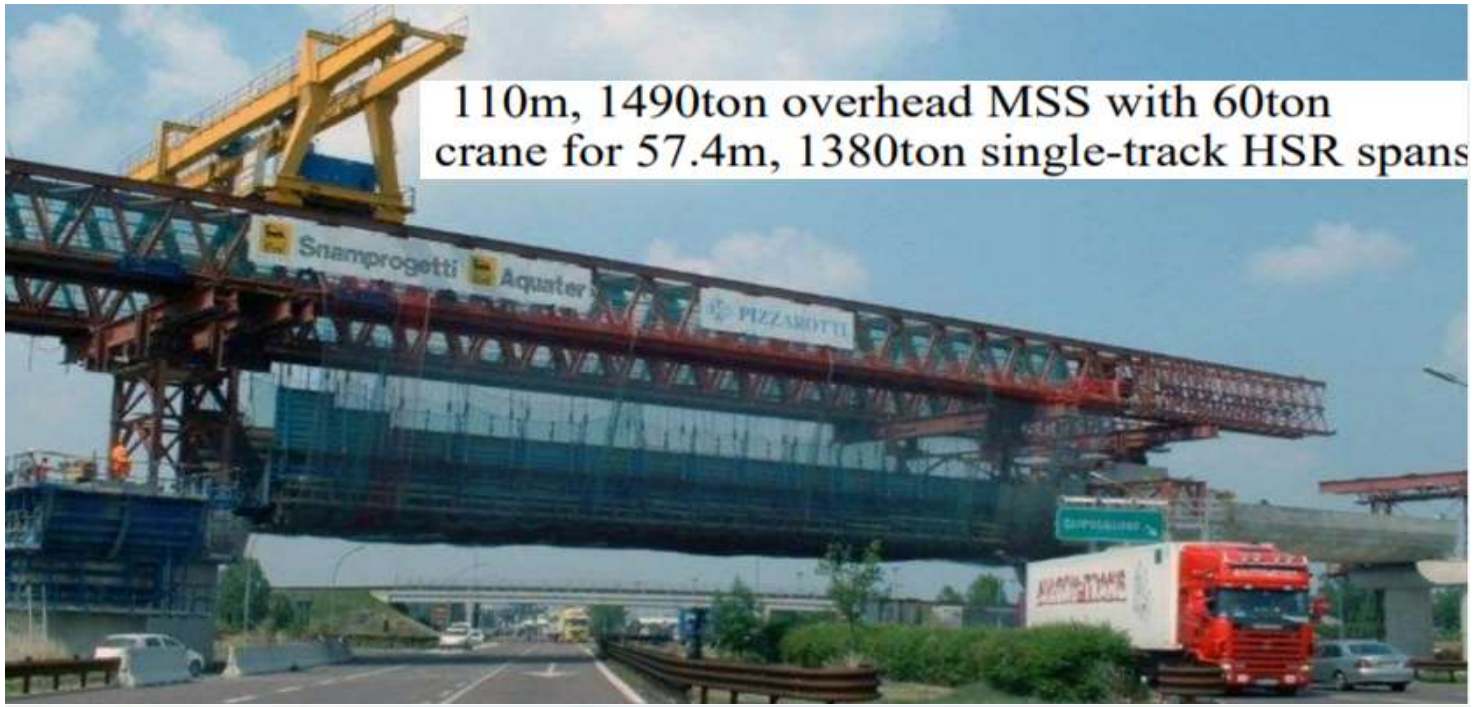
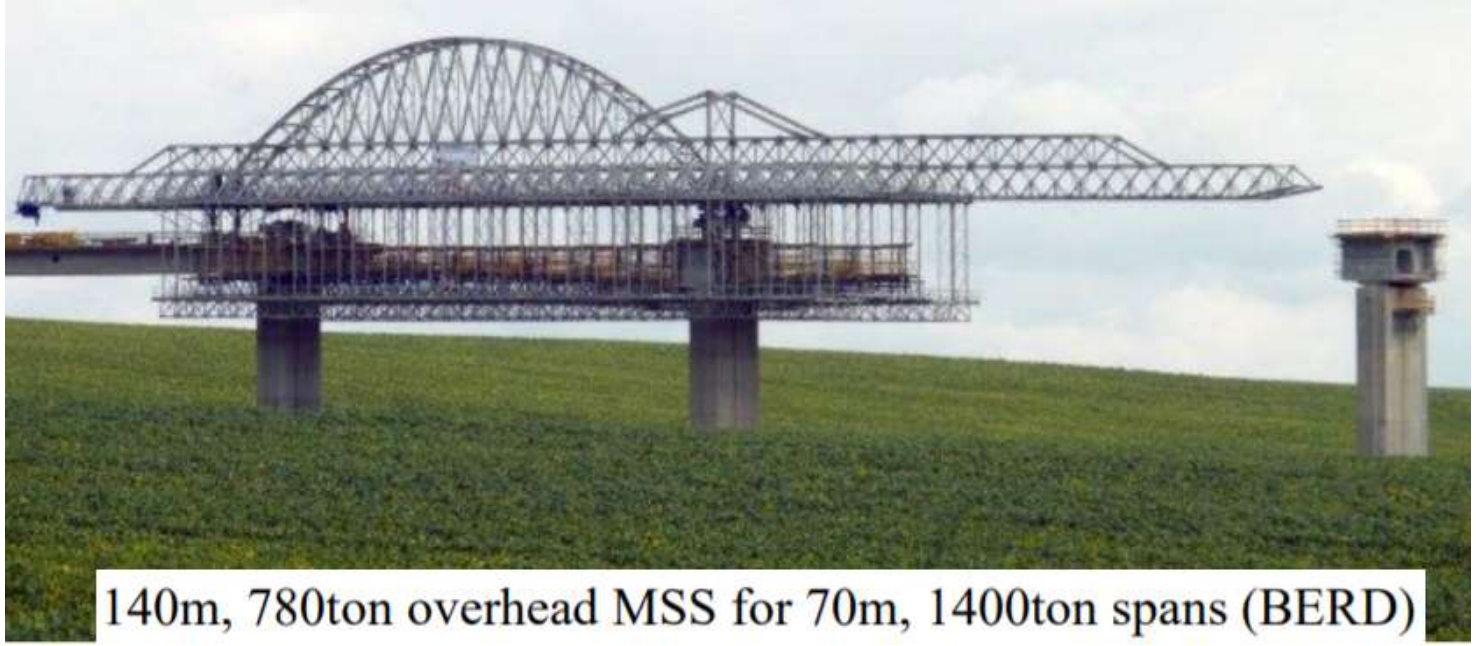
D) EJECUCIÓN, IN SITU, A VANO ENTERO

SISTEMA DE ENCOFRADO MÓVIL (*MOVABLE SCAFFOLDING SYSTEM*)

Opened outer form during launching
(AP Bridge Construction Systems)



110m, 1490ton overhead MSS with 60ton crane for 57.4m, 1380ton single-track HSR spans


140m, 780ton overhead MSS for 70m, 1400ton spans (BERD)

74m, 98ton single-girder shifter for 28m, 60ton beams (Deal)

E) EQUIPO DE LANZAMIENTO DE VIGAS (DOBLE T, ARTESA, ETC.) SEGMENTACIÓN LONGITUDINAL EN ESTOS CASOS, LA LOSA DE TABLERO SE EJECUTA IN SITU O POR PANELES PREMOLDEADOS

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EQUIPOS DE MONTAJE

IZAJE DE DOVELAS MEDIANTE GRÚAS SOBRE VIGAS LATERALES (UNDERHEAD)

Segment support under the side wings (Photo: VSL)

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EQUIPO DE TRANSPORTE Y EQUIPO DE LANZAMIENTO A VANO ENTERO.

Figure 12. Short launcher with two-span underbridge for 32.7 m (107 ft), 9000 kN (2020 kip) dual-track box girders. *Courtesy of BWM.*

Figure 9. Extraction saddle of a tire trolley for 4000 kN (900 kip) single-track box girders. *Courtesy of BWM.*

IZAJE, TRANSPORTE Y MONTAJE *FULL SPAN*

LA VIGA MONTADA, MOSTRADA EN LAS IMÁGENES POSEE UN PESO PROPIO DE 900 T

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Articulated underslung gantry for bifurcations (Photo: Strukturas)

Varying-width portal crane (Photo: NRS)

Articulated underslung gantry (Photo: NRS)

EQUIPO DE LANZAMIENTO INFERIOR (*UNDERSLUNG GANTRY*) ARTICULADO QUE PERMITE LA BIFURCACIÓN Y CURVA DE LA TRAZA. PÓRTICO DE ANCHO VARIABLE

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MONTAJE DE DOVELAS MEDIANTE EQUIPO AUTO LANZADOR TELESCÓPICO

Telescopic gantry (Photo: Deal)

Erection of shorter spans (Photo: Deal)

Telescopic gantry negotiating tight plan and vertical radii

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Figure 9. This heavy twin-upper-truss unit is for precast concrete macrosegmental erection.

Figure 3. This shows a twin-upper-beam gantry with support cross beams. Photograph courtesy of NRS.

MONTAJE DE DOVELAS U Y CAJÓN (MACROSEGMENTOS) MEDIANTE EQUIPO AUTO LANZADOR DE VIGAS "MELLIZAS" RETICULADAS SUPERIORES (*TWIN UPPER TRUSS*)

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SECCIONES USUALES. PRE Y POSTESADO, MIXTOS HORMIGÓN - ACERO

ARTESA + LOSA IN SITU O PANELES

CAJÓN UNICELULAR

CAJÓN MIXTO
HORMIGÓN
ACERO

VIGA U

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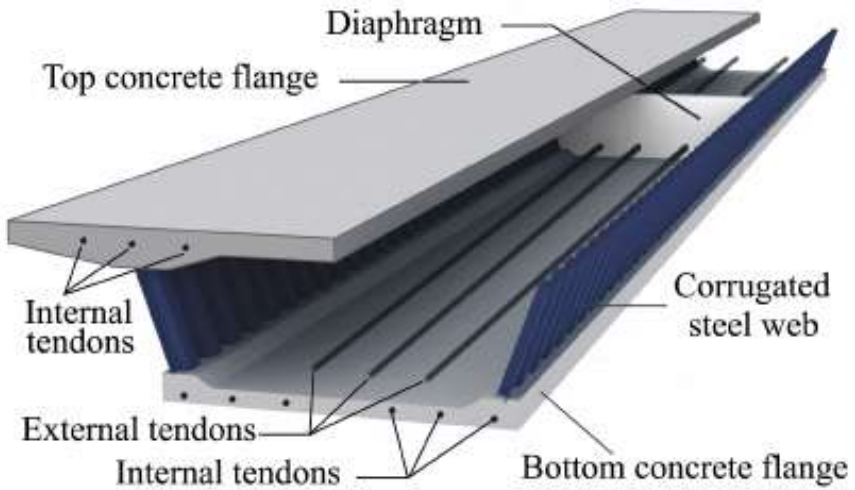
SECCIONES MENOS USUALES.

CAJÓN MULITICELULAR

CAJÓN POSTESADO CON ALMAS DE ACERO CORRUGADO O RETICULADO



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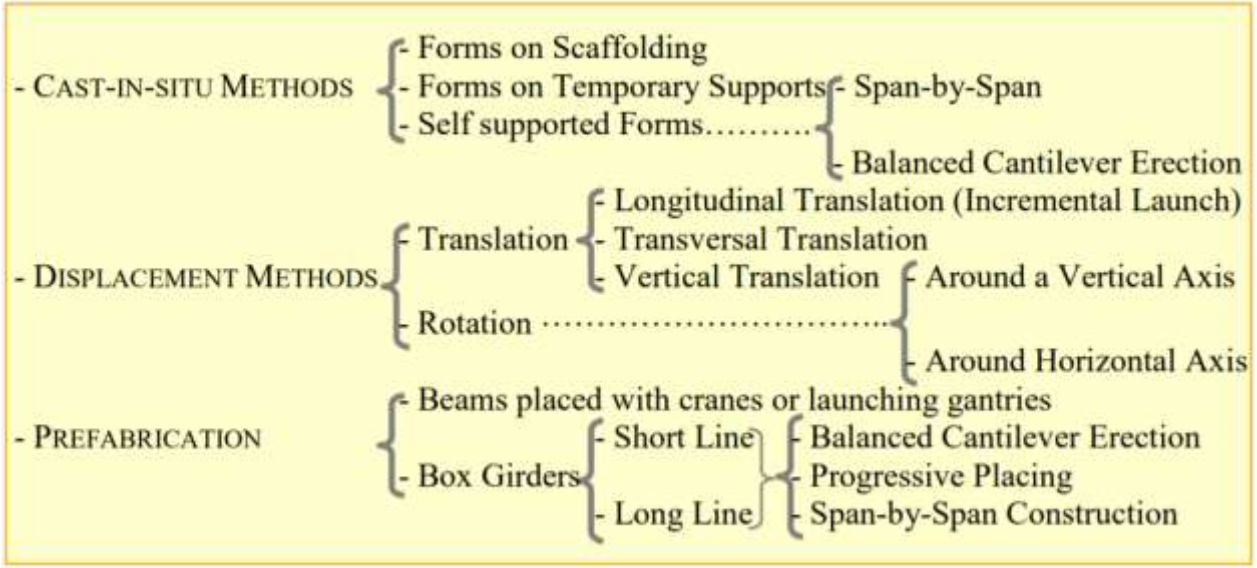
CONSTRUCCIÓN
PREMOLDEADA / IN SITU
SISTEMAS



Classification of Concrete Structures according to Construction Methods

Precast Segmental Erection

- Balanced Cantilever Erection with Launching Gantry
- Span by Span Erection with Launching Gantry
- Balanced Cantilever Erection with Lifting Frames
- Balanced Cantilever Erection with Cranes
- Precast Beam Method
- Full Span Precast Method
- Span by Span Erection on Falsework

Insitu Construction

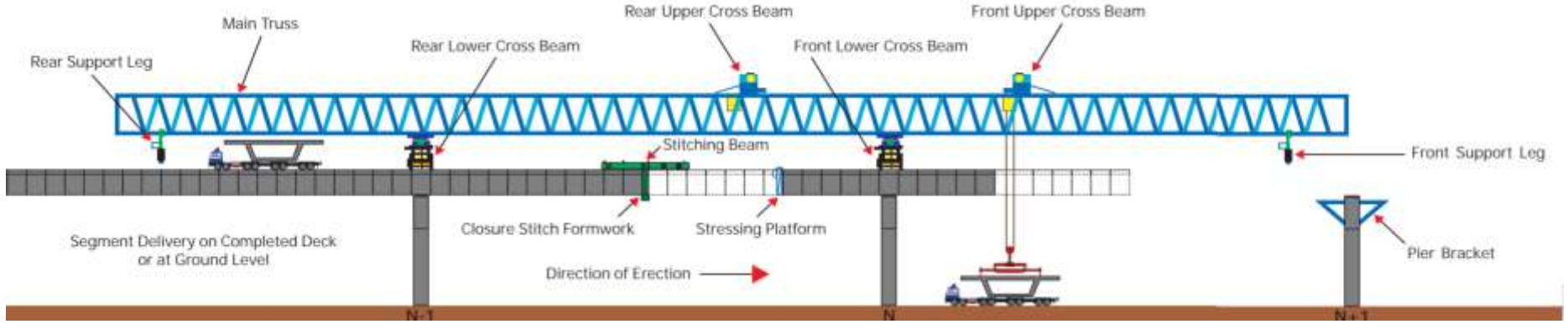
- Incremental Launching Method
- Form Traveller Method

CICLO DE CONSTRUCCIÓN POR LANZAM. DE VOLADIZOS BALANCEADOS CON VIGA LANZADORA

FEATURES & ADVANTAGES

- Delivery of segments along completed deck to rear of gantry minimises disruption to existing traffic networks.
- Necessary temporary works require little ground improvement and are generally elevated, therefore causing minimal disruption to existing roads, structures or services.
- Support craneage is reduced due to temporary works being relocated by gantry.
- Clear, unobstructed access to all work fronts is provided within gantry system.
- Work can proceed on multiple work fronts within the gantry, i.e pier segment erection, cantilever construction and closure pour construction.
- Temporary loads are introduced directly into piers.

Typical Erection Cycle	Duration: 6 Shifts					
Description	1	2	3	4	5	6
Span N-1						
Curing of Stitch (Overnight)						
Continuity P.T.						
Span N						
Launch Gantry to Span N						
Segment Erection Span N						
Stitch N to N-1						
Span N+1						
Erect Pier Segment						
Align Pier Segment						
Place Reinforcement						
Place Formwork						
Cast Insitu Diaphragm						
Curing Pier/Column Joint						

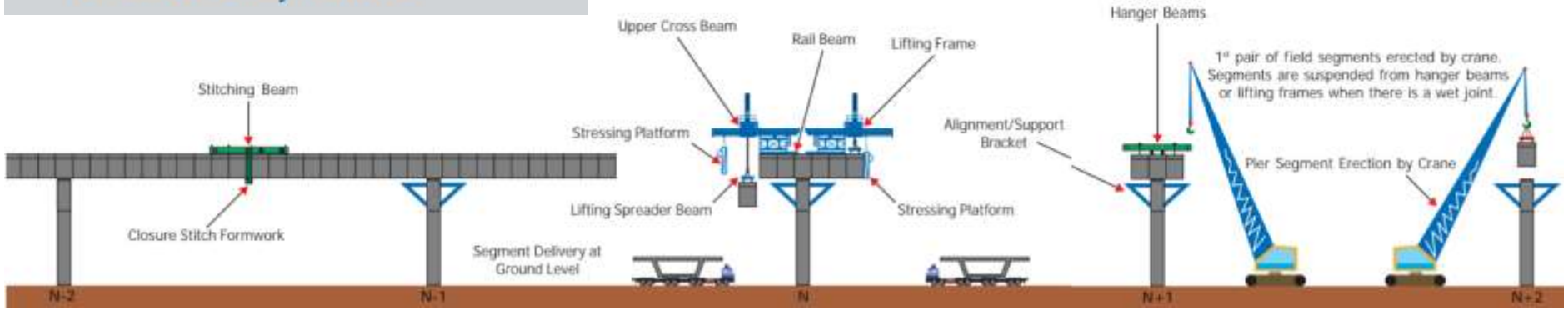


CICLO DE CONSTRUCCIÓN POR VOLADIZOS BALANCEADOS CON PÓRTICOS DE IZAJE

FEATURES & ADVANTAGES

- Relatively simple temporary works requirements.
- High rates of erection.
- Large segments can be erected.
- Optimised crew cycles.
- Multiple levels of segment alignment and adjustment are possible.
- Strand lifting units can be adopted and provide several levels of safety features.

Typical Erection Cycle	Duration: 13 Shifts												
Description	1	2	3	4	5	6	7	8	9	10	11	12	13
Erect & Assemble Lifting Frames & Brackets on Pier Head	■	■	■										
Segment Erection - Pair 1				■									
Wet Joint Construction					■								
Wet Joint Curing					■	■							
Segment Erection - Pair 2-3							■						
Segment Erection - Pair 4-5								■					
Segment Erection - Pair 6-7									■				
Segment Erection - Pair 8-9										■			
Segment Erection - Pair 10-11											■		
Segment Erection - Pair 12-13												■	
Remove Lifting Frames													■

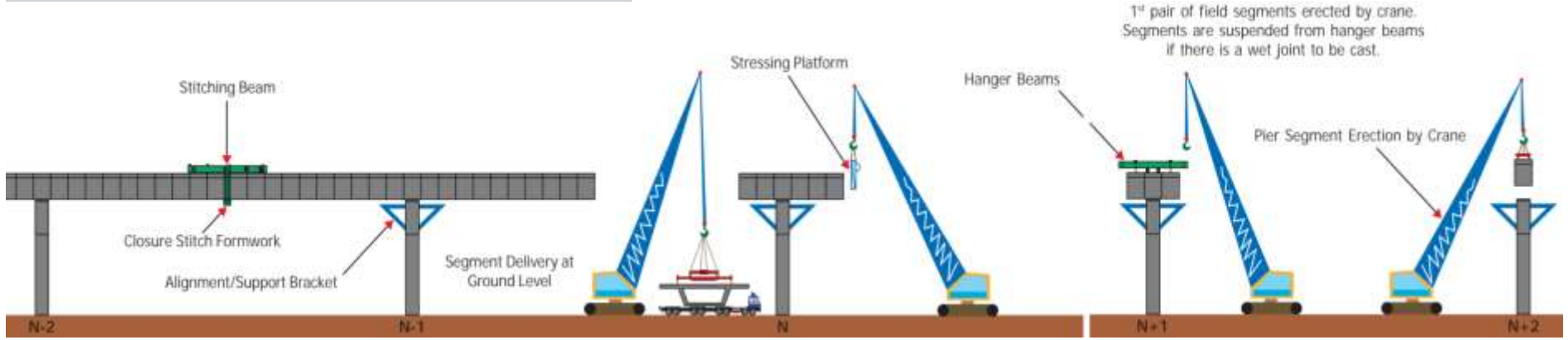


CICLO DE CONSTRUCCIÓN POR VOLADIZOS BALANCEADOS CON GRÚAS

FEATURES & ADVANTAGES

- Temporary works requirements are minimised.
- Fast rates of erection are possible.
- Multiple work fronts are possible.
- Optimised crew size.
- Minimal engineering requirements.
- Cranes are generally readily available in the market.
- Cranes can be utilised to execute other activities.

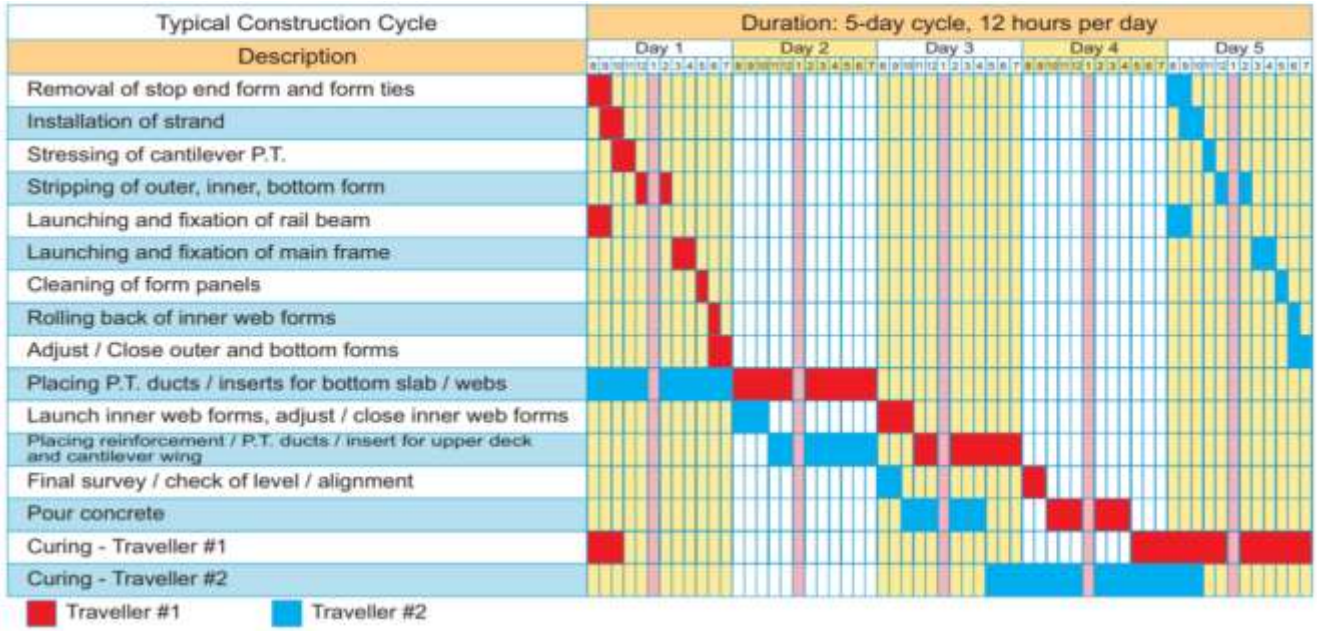
Typical Erection Cycle	Duration: 8 Shifts							
Description	1	2	3	4	5	6	7	8
Installation of Pier Segment Support Brackets								
Installation of Pier Segment								
Segment Erection - Pair 1-3								
Segment Erection - Pair 4-6								
Segment Erection - Pair 7-9								
Segment Erection - Pair 10-12								

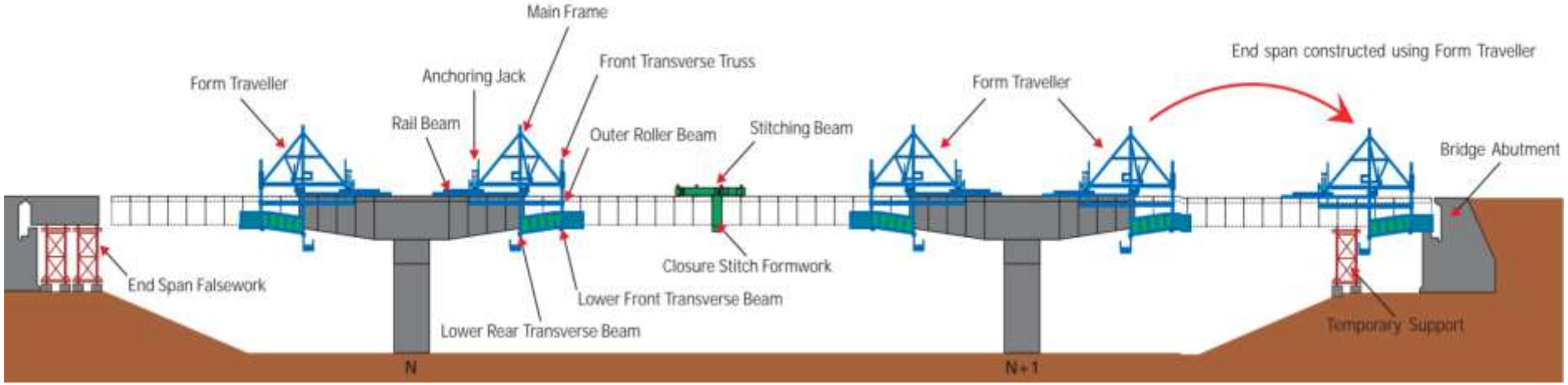


CICLO DE CONSTRUCCIÓN POR VOLADIZOS BALANCEADOS - IN SITU

FEATURES & ADVANTAGES

- Long-span bridge structures with access constraints can be easily accommodated.
- Craneage capacity requirements are minimised.
- Crew efficiency between 1 pair of form travellers is optimised.





Precast Segmental – Span-by-Span

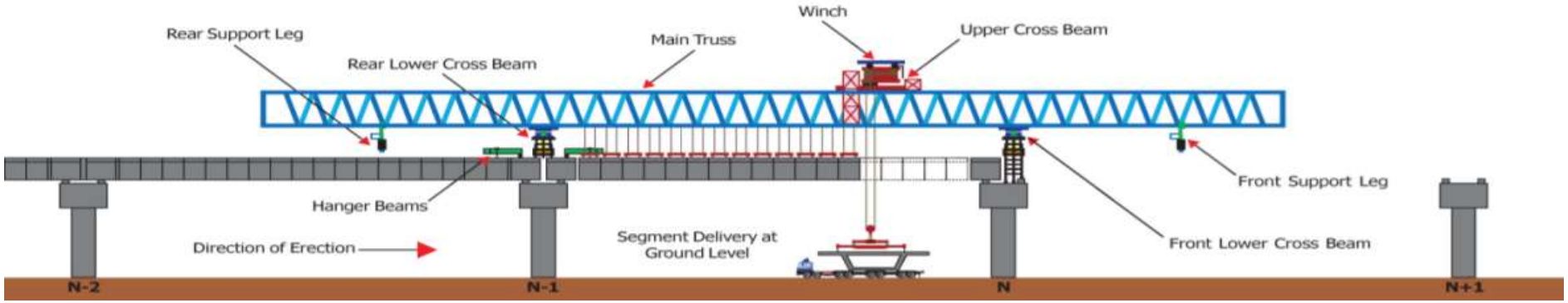
Erection with Launching Gantry (Overhead or Underslung)

- Spans typically < 170 ft
- Speed of Erection (1 span per day possible)
- Small Crew
- Delivery from behind or below
- Temp load directly into Piers

Typical Erection Cycle	Duration: 4-Day Cycle							
Description	1		2		3		4	
	D/S	N/S	D/S	N/S	D/S	N/S	D/S	N/S
Launching of Gantry								
Segment Placing								
Segment Alignment / Gluing								
Wet Joint Casting								
Curing (Overnight)								
Installation of External P.T.								
Stressing of External P.T.								

CICLO DE CONSTRUCCIÓN POR LANZAM.

VANO A VANO



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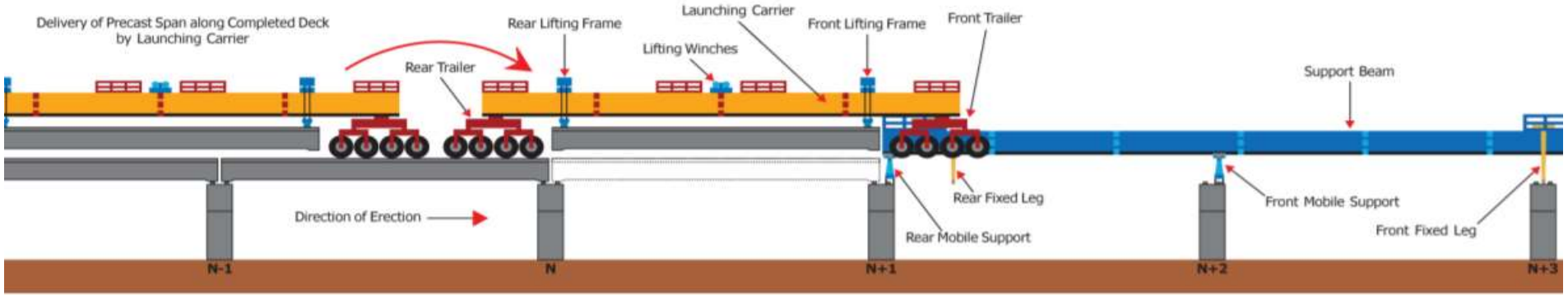
Precast Segmental – Full Span

Erection with Launching Gantry

- Typically short spans
- Very high rate of erection
- Factory casting environment - Very high quality
- Min follow up work
- Large temporary loads

Typical Erection Cycle	Duration: 1-Day Cycle (Hours)																		
Description	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Delivery New Span from Yard to Erection Site																			
Erection of New Span																			
Return Launching Carrier to Yard																			
Launching Carrier Available for Yard Handling																			
Load New Segment into Launching Carrier																			
Load Transfer from Temporary to Permanent Bearings																			
Prepare Permanent Bearings for Grouting																			
Grout Permanent Bearings																			



CICLO DE CONSTRUCCIÓN POR LANZAM.

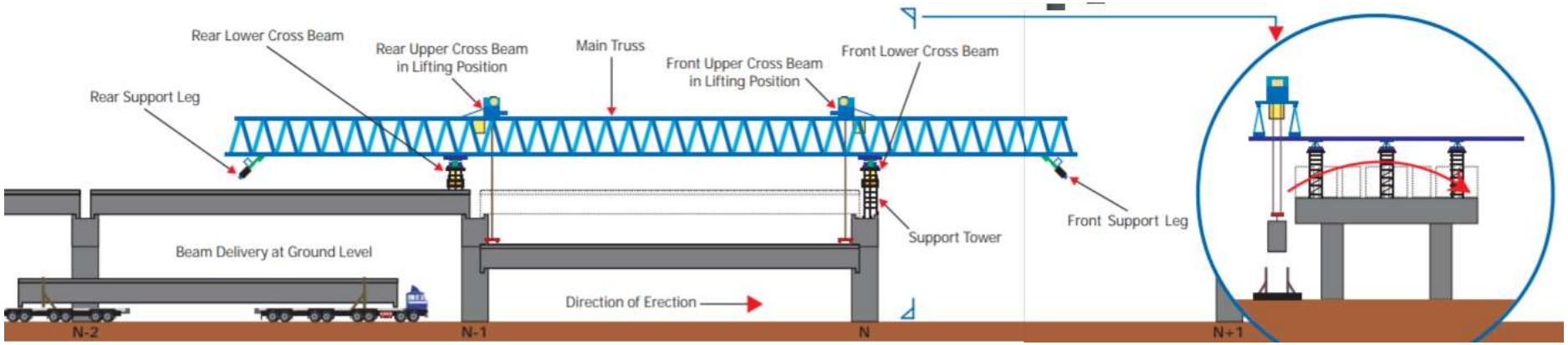
VANO ENTERO

CICLO DE CONSTRUCCIÓN POR LANZAM. VIGAS PREMOLDEADAS INDIVIDUALES

FEATURES & ADVANTAGES

- Fast rates of erection.
- Relatively simple erection gantry, or crane erection.
- Beam delivery possible along completed deck to rear of gantry, thus minimising disruption to existing traffic networks.
- Small works crew size.
- Geometry control is minimised.
- Precast beam production is relatively simple and requires low levels of mechanisation.

Typical Erection Cycle	Duration: 2-Shift Cycle (Hours)	
Description	Shift - 1 (10 Hour Shift)	Shift - 2 (10 Hour Shift)
Lift and place 1st beam (outer most) with precast plank on top		
Lift and place 2nd beam with precast plank on top		
Lift and place 3rd beam with precast plank on top		
Lift and place 4th beam with precast plank on top		
Reposition the intermediate planks into final position		
Move gantry to center viaduct then launch to next span		

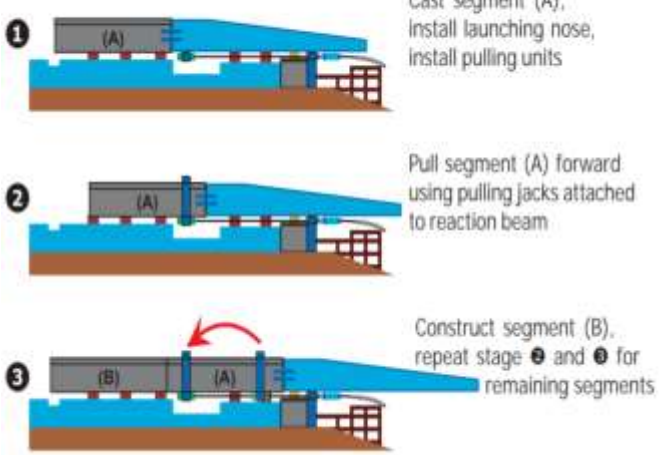


CICLO DE CONSTRUCCIÓN POR LANZAMIENTO INCREMENTAL (EMPUJE O ARRASTRE)

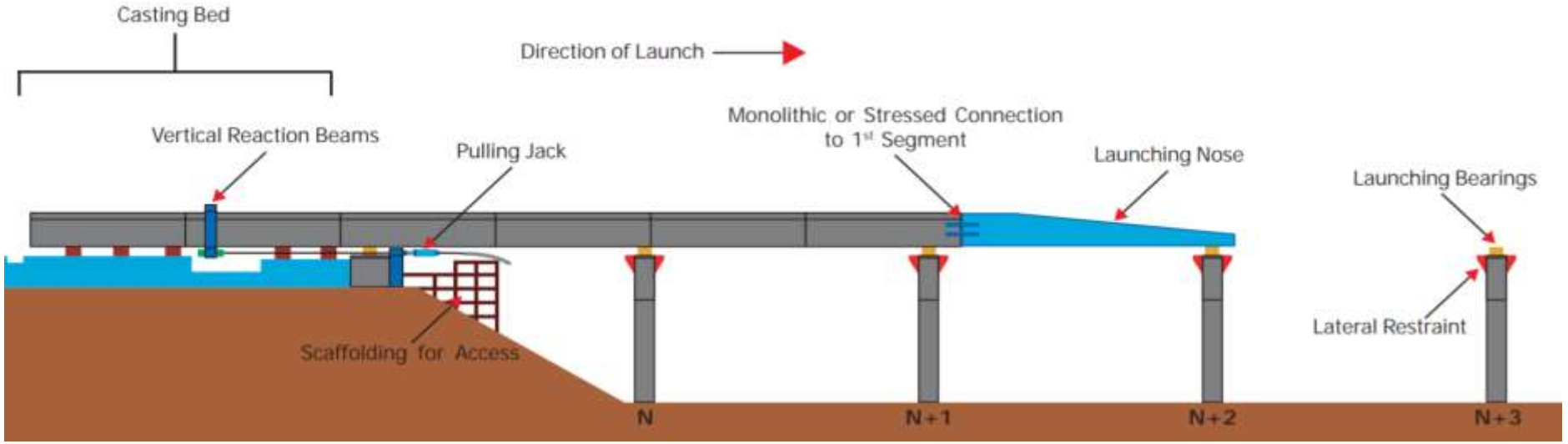
FEATURES & ADVANTAGES

- Concentrated work front optimises craneage requirements.
- Site constraints such as poor ground and access restriction can be minimised.
- Minimal temporary works.
- Seven-day cycle is achievable if overtime is allowed.
- Require only a moderate investment in specialised equipment such as launching nose, launching jacks, conventional jacks, launching bearings and guides.

TYPICAL CONSTRUCTION SEQUENCE



Typical Construction Cycle	Duration: 8-Day Cycle (Days)							
Description	1	2	3	4	5	6	7	8
Launch Segment								
Strip and Clean Forms								
Install Base and Web Rebar								
Install Web Forms								
Concrete Base and Webs								
Install Inner Forms								
Install Top Slab Rebar								
Concrete Top Slab								
Curing								
Stress P.T.								

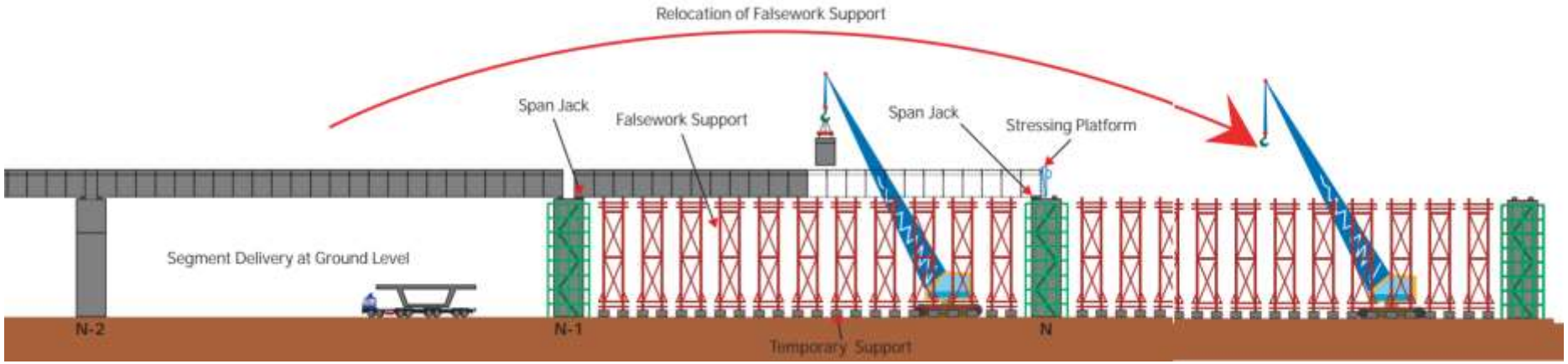


CICLO DE CONSTRUCCIÓN POR SEGMENTOS MEDIANTE GRÚAS Y APUNTALAMIENTO

FEATURES & ADVANTAGES

- Minimised engineering requirements are possible.
- Modular support system can be relocated with ease and relatively quickly.
- Work can proceed on multiple work fronts.
- Production crew size is fully utilised and optimised.
- Good access is provided to all work fronts.

Typical Erection Cycle	Duration: 4-Day Cycle (Days)			
Description	1	2	3	4
Installation of Scaffold Support				
Erection of Segments				
Alignment and Gluing				
Post Tensioning Operations				
Load Transfer onto Permanent Bearings				



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SISTEMAS Y FACILIDADES DE CONSTRUCCIÓN

Figure 4. Reinforcing bar jig for full-span cage prefabrication of a single-track U beam.

Figure 13. The prefabricated cage for the entire span is being inserted into the casting cell.

Figure 6. Casting cell for combined pre- and posttensioning. *Courtesy of VSL.*

MOLDES PARA VIGAS ENTERAS TIPO U Y CAJÓN, PARA SECCIONES PRE Y POSTESADAS O COMBINADOS

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SISTEMAS Y FACILIDADES DE CONSTRUCCIÓN

Ground transportation of segments (Photo: IABSE WG-6 Singapore)

PLANTA DE CONSTRUCCIÓN Y ACOPIO DE PREMOLDEADOS

Segment delivery on the ground (Photo: VSL)

Rectangular precasting facility (Photo: Kiewit)

ACOPIO DE SEGMENTOS

TRANSPORTE DE SEGMENTOS

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SISTEMAS Y FACILIDADES DE CONSTRUCCIÓN

Sheltered casting lines (Photo: IABSE WG-6 Singapore)

Straddle carrier for segment handling (Photo: IABSE WG-6 Singapore)

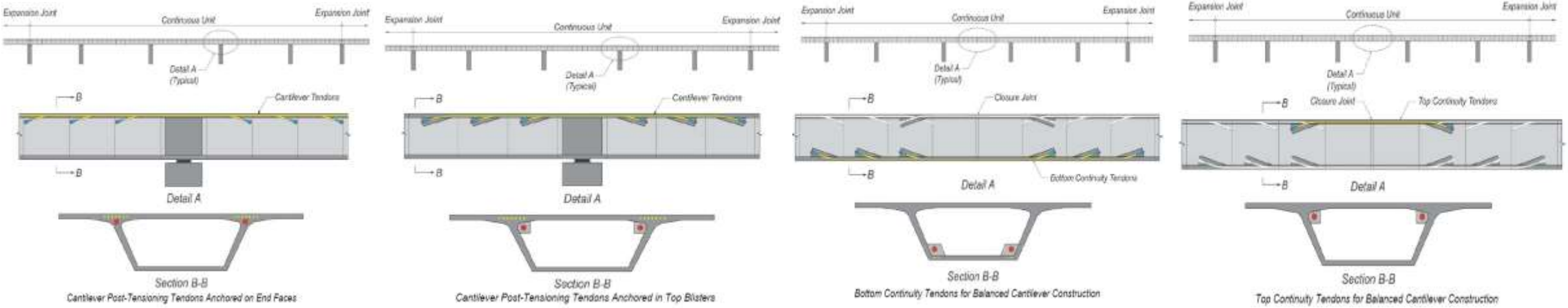
NAVE DE PREMOLDEADOS, MOLDES Y PÓRTICOS DE MOVIMIENTOS DENTRO DE LA PLANTA

Core form (Photo: IABSE WG-6 Singapore)

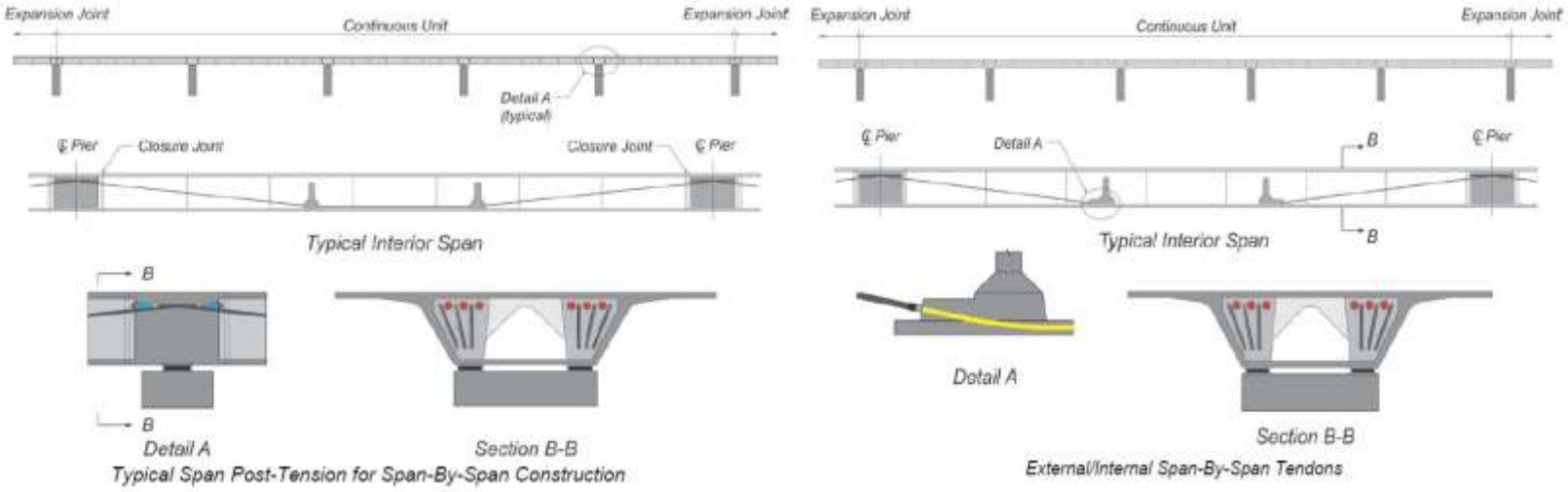
CICLO DE SEMINARIOS WEB

DISEÑO Y CARACTERÍSTICAS SIST. DE TESADO

VOLADIZOS BALANCEADOS – SISTEMA DE CABLEADO DE VOLADIZO Y CONTINUIDAD



VANO A VANO – SISTEMA DE CABLEADO EXTERNO Y MIXTO



PT ext. (no adherente): Mejora tiempos de ejecución, facilidad de inspección y reemplazo de cables, no requiere sellado de juntas con resina epoxi. Requiere mayor cuantía de acero teso por menor excentricidad. El acero teso no llega a fluencia en ULS.

PT int. y mixto (adherente): Ventajas y desventajas inversas.

CICLO DE
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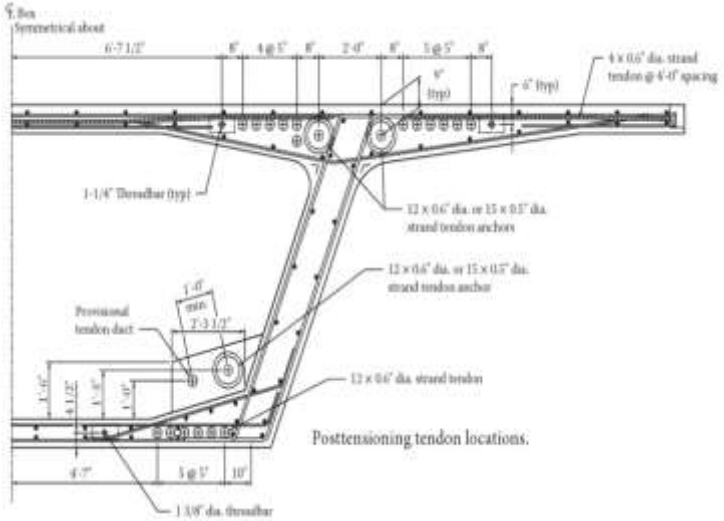
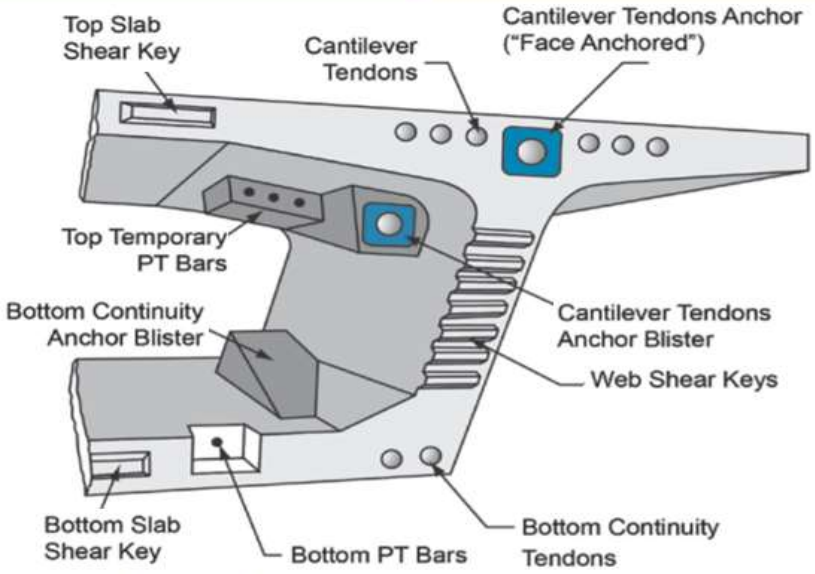
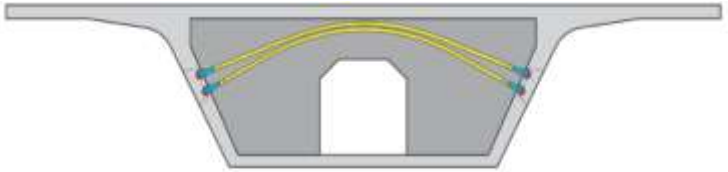




Typical Balanced Cantilever Segment

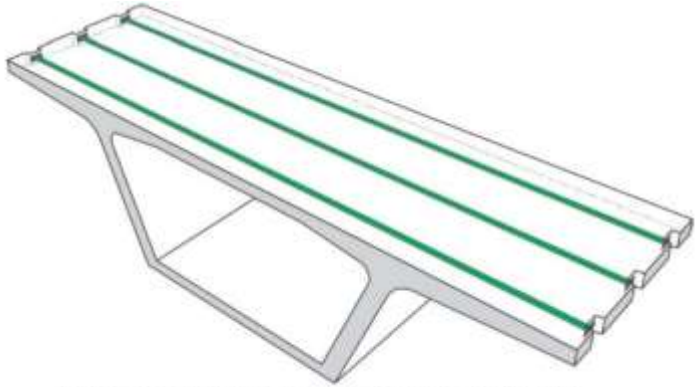
Transverse Post-Tensioning in Deviation Ribs

Vertical Post-Tensioning in Webs



Transverse Post-Tensioning in Diaphragms

Vertical Post-Tensioning in Diaphragms



Transverse Post-Tensioning in the Top Slab of Box Girder

SECCIÓN TRASNV. TÍP.

CABLES INT/EXT, BLISTERS, BARRAS PT (TEMP), LLAVES DE CORTE

RELACIONES Y CUANTÍAS ORIENTATIVAS VIGAS CAJÓN (V vial - F ferroviario)

VANO A VANO-L/H (S.A.-Hcte):	V 18 a 22	F 14 a 18
VANO A VANO-L/H (C.-Hcte):	V 20 a 25	F 16 a 20
VANO A VANO-L/H (C.-Hvar):	V 33 a 50 / 14 a 20	F 26 a 40 / 12 a 16
VOLAD. BALAC-L/H (C.-Hcte):	V 20 a 25	F 16 a 20
VOLAD. BALAC-L/H (C.-Hvar):	V 33 a 50 / 14 a 20	F 26 a 40 / 12 a 16
CUANTÍA TESA (kg/m3):	V 40/50	F 60/70
CUANTÍA NO TESA (kg/m3):	V 90/150	F 140/150
ESP. PROM. HORMIGÓN (m):	V 0.45/0.7	F 0.55/0.9 (Vol / B losa sup)

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SISTEMA DE EJECUCIÓN POR DOVELAS CONJUGADAS ASEGURA CORRECTO ENCASTRE TANTO EN TRAMOS RECTOS COMO EN CURVOS EN EL PLANO VERTICAL Y HORIZONTAL Y PERALTADOS

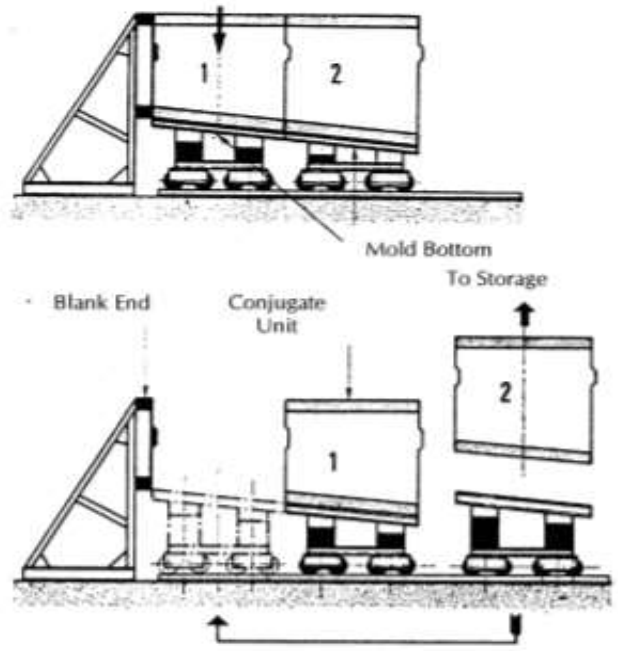


FIGURE 11.44 Typical short-line precasting operation.

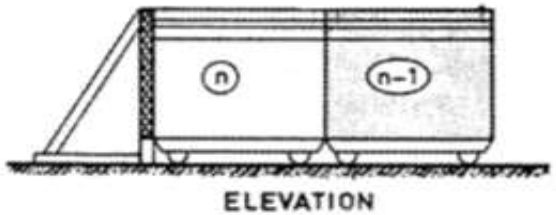


FIGURE 11.45. Straight bridge.

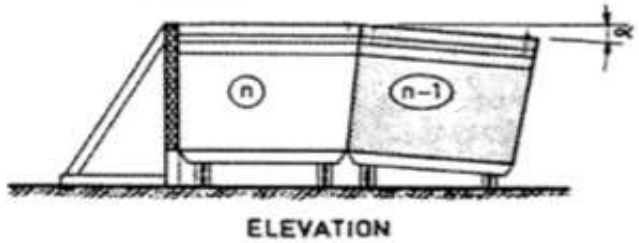


FIGURE 11.46 Bridge with vertical curve.

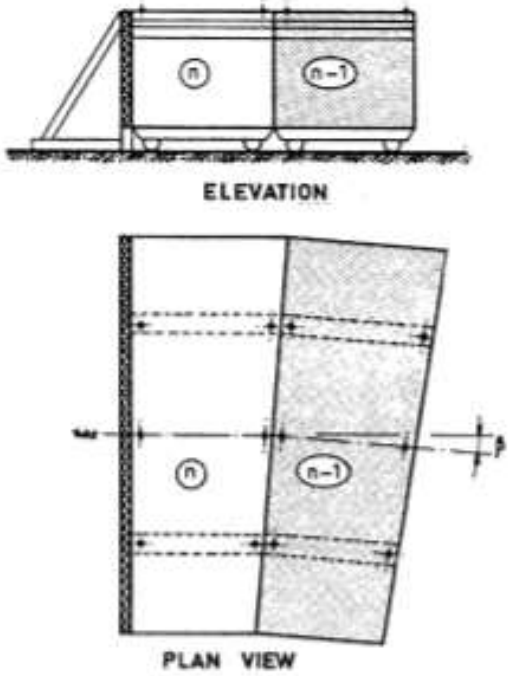


FIGURE 11.47 Bridge with horizontal curve.

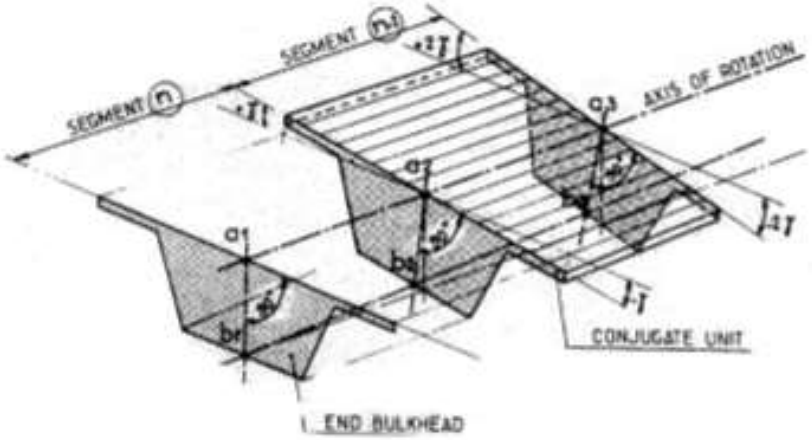
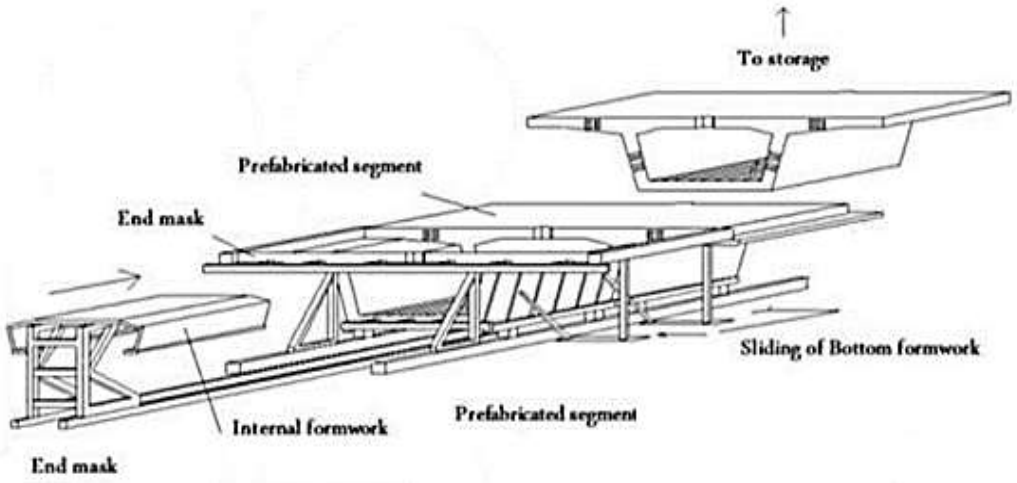


FIGURE 11.48 Bridge with superelevation.

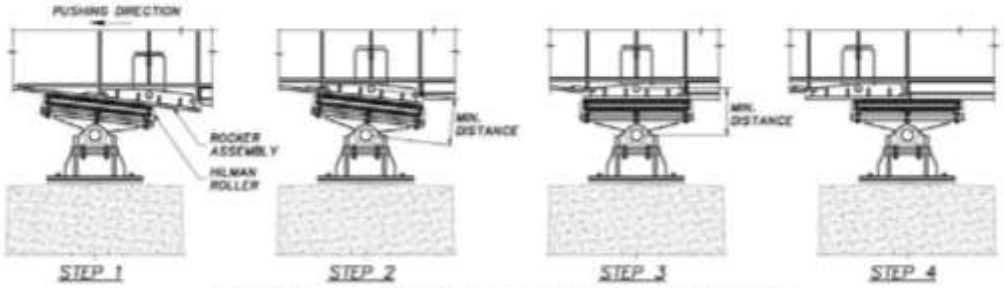


CICLO DE
SEMINARIOS WEB

VIADUCTOS MIXTOS

- IZAJE VERTICAL
- IZAJE POR GRÚAS
- VOLADIZOS SUCESIVOS
- LANZADOS

Launch nose (left) and girders (right) supported by a Hilman Roller during the launch

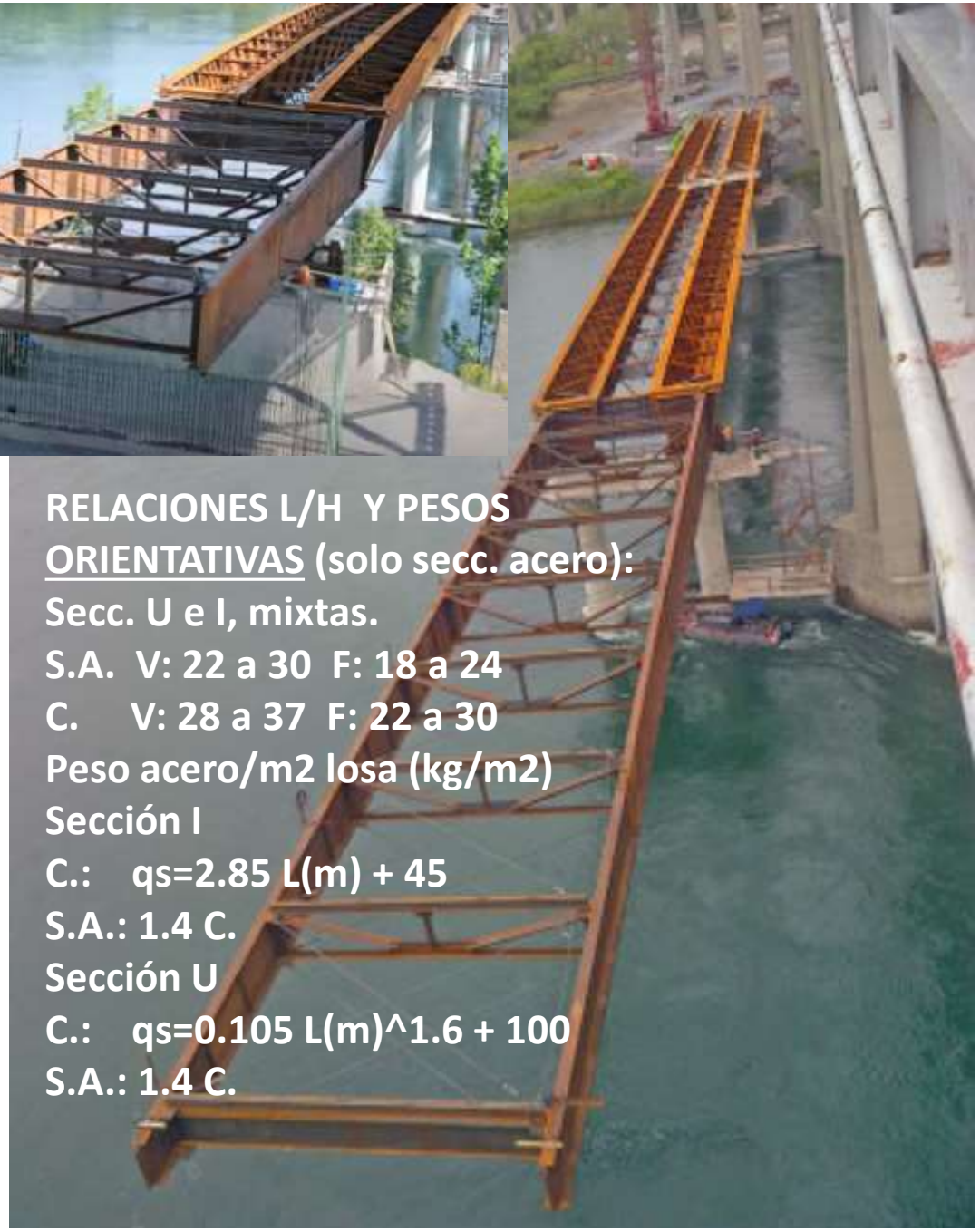


Rocker assembly working mechanism

CICLO DE SEMINARIOS WEB

VIADUCTOS MIXTOS

Girder bridge of double composition over the Santa Lucia in Uruguay



RELACIONES L/H Y PESOS ORIENTATIVAS (solo secc. acero):

Secc. U e I, mixtas.

S.A. V: 22 a 30 F: 18 a 24

C. V: 28 a 37 F: 22 a 30

Peso acero/m2 losa (kg/m2)

Sección I

C.: qs=2.85 L(m) + 45

S.A.: 1.4 C.

Sección U

C.: qs=0.105 L(m)^1.6 + 100

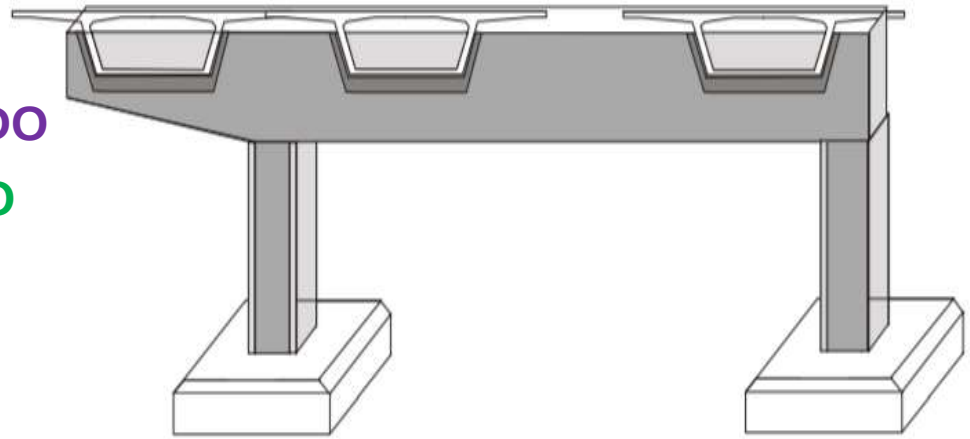
S.A.: 1.4 C.

CICLO DE SEMINARIOS WEB

PILAS DE APOYO

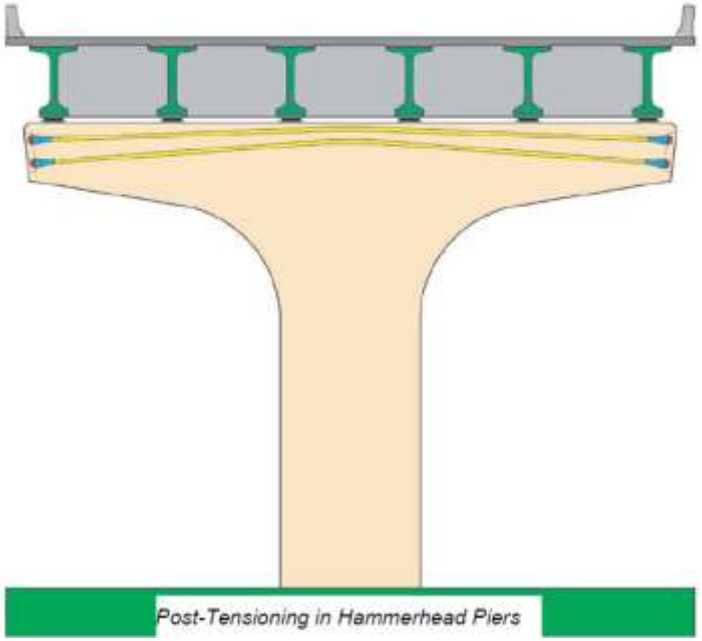
HORMIGÓN ARMADO

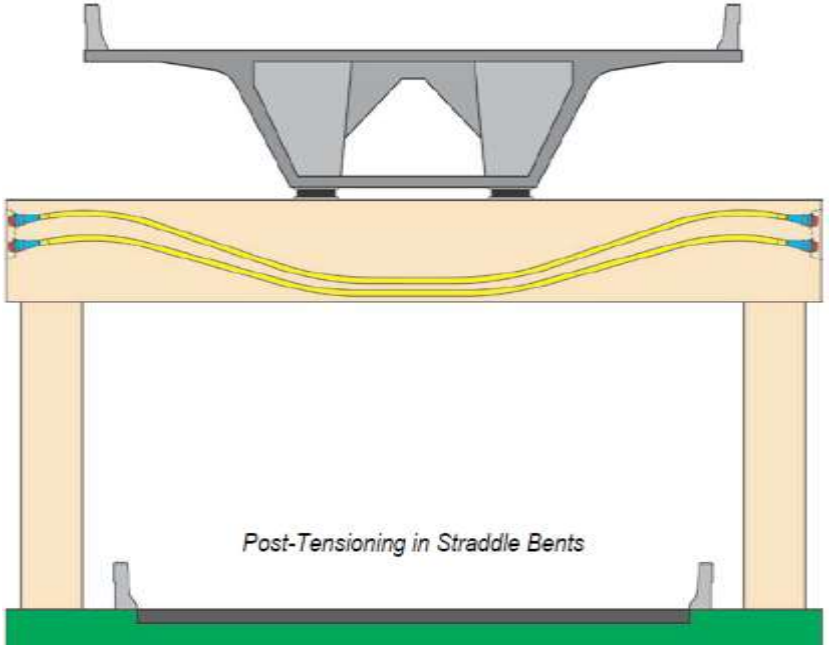
O PRE/POSTESADO

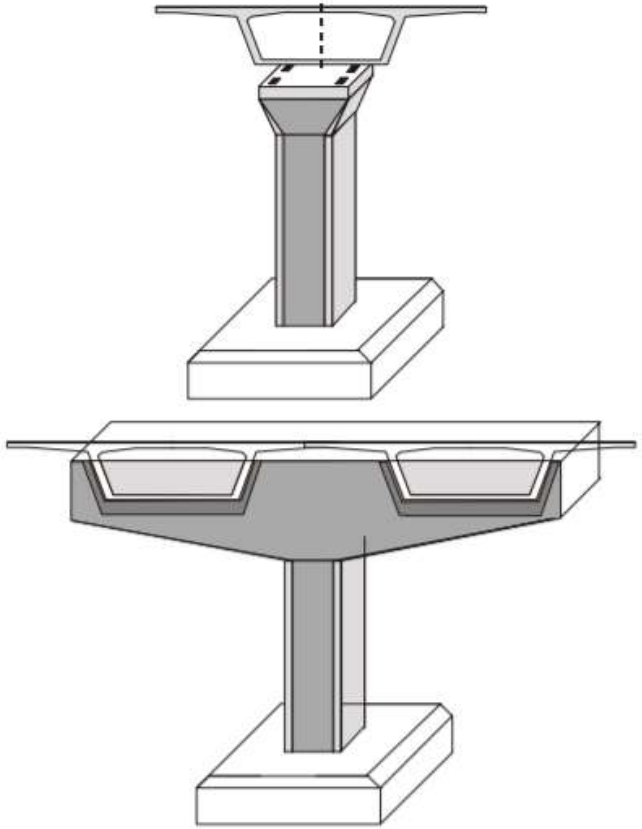


ESQUEMAS TÍPICOS DE PILAS DE APOYO

- CAPILTEL Y MONOCOLUMNA
- DINTEL Y MONOCOLUMNA
- DINTEL Y MÚLTIPLES COLUMNAS



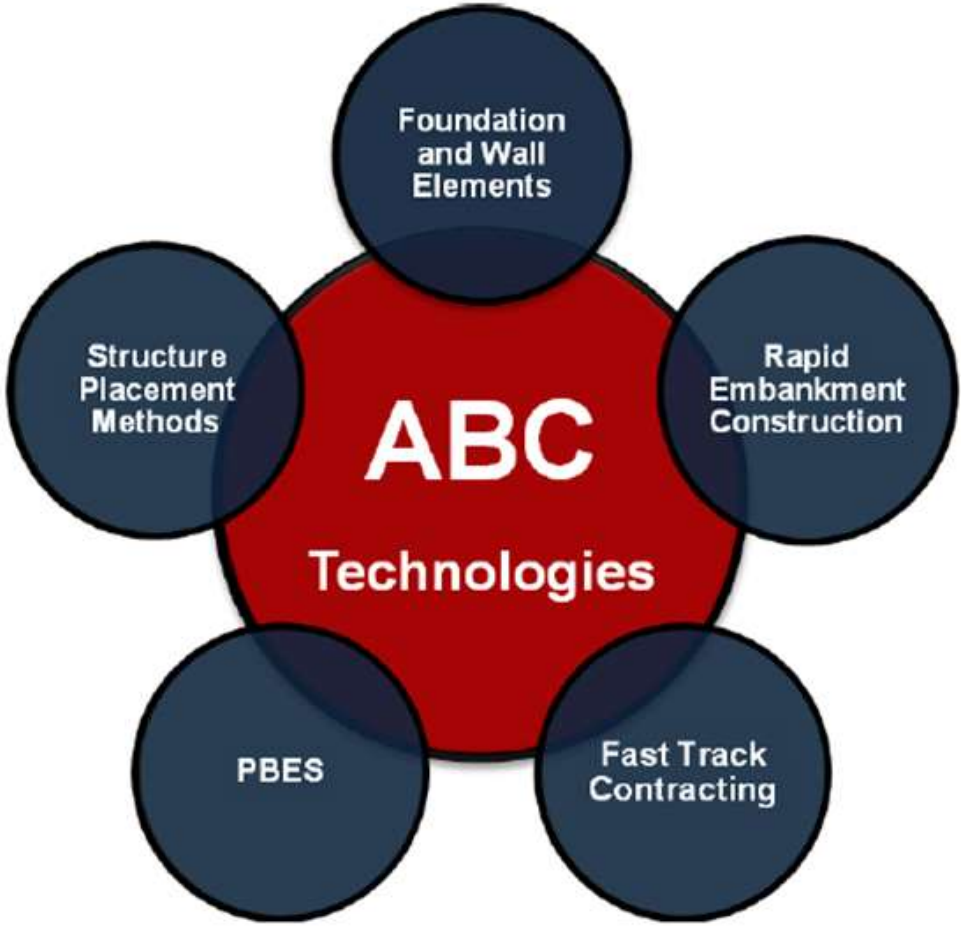




CICLO DE SEMINARIOS WEB

ABC ACCELERATED BRIDGE CONSTRUCTION

MÉTODO "ABC" DE CONSTRUCCIÓN ACELERADA DE PUENTES. PRINCIPALMENTE BASADO EN ELEMENTOS PREFABRICADOS DE FÁCIL TRANSPORTE Y RÁPIDO MONTAJE



Accelerated Bridge Construction Technologies
source: FHWA Every Day Counts Initiative)

MEJORA:

- FACILIDAD CONSTRUCTIVA IN SITU
- TIEMPO TOTAL DE CONSTRUCCIÓN
- SEGURIDAD PARA EL TRÁNSITO PÚBLICO EN OBRA

REDUCE:

- PERTURBACIÓN DEL TRÁFICO
- TIEMPO DE EJECUCIÓN IN SITU
- DEMORAS POR CUESTIONES CLIMÁTICAS

EN SÍNTESIS MEJORA LA CONSTRUCTIVIDAD Y TIEMPOS DE EJECUCIÓN. REDUCE COSTOS REQUIERE MAYOR EXPERTISE DE INGENIERÍA Y MANAGEMENT.

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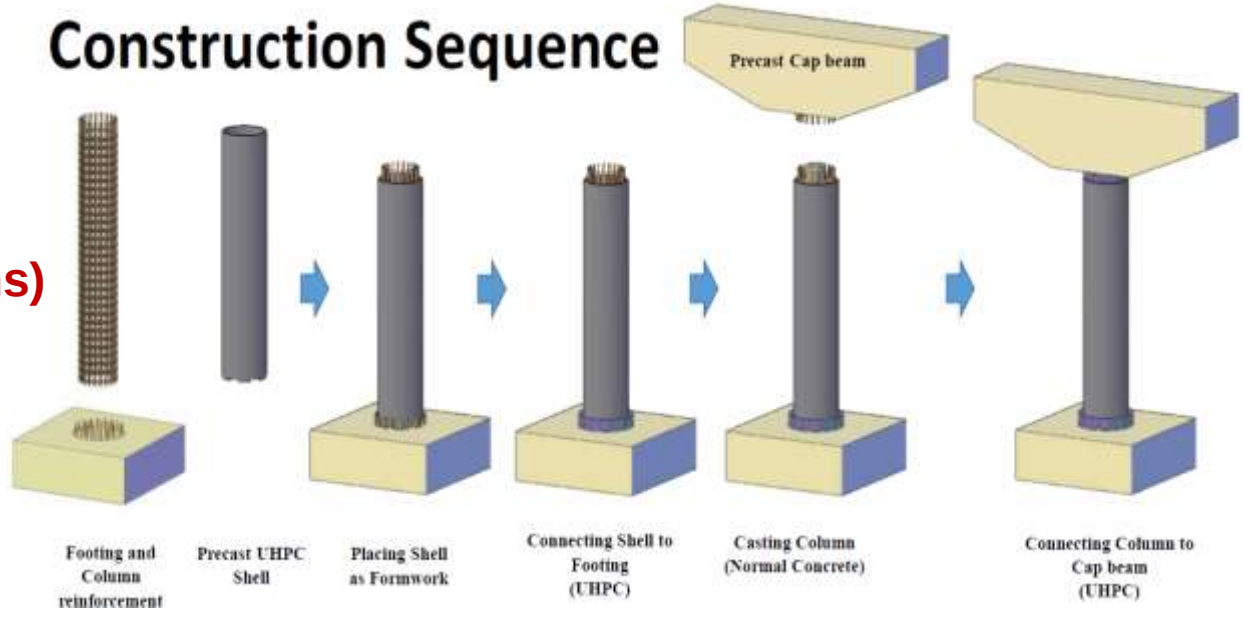
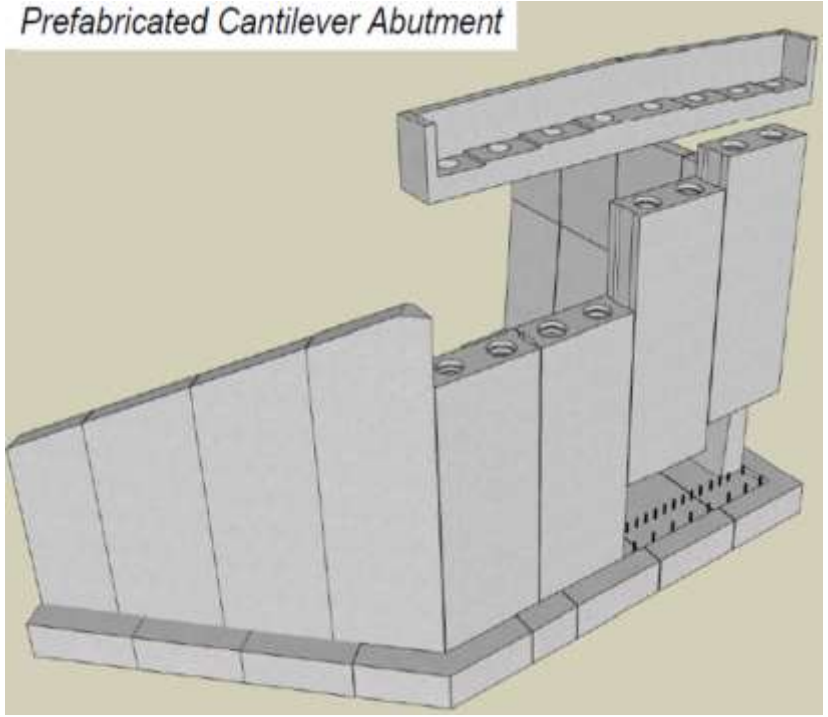
PBES (Prefabricated Bridge Elements and Systems)

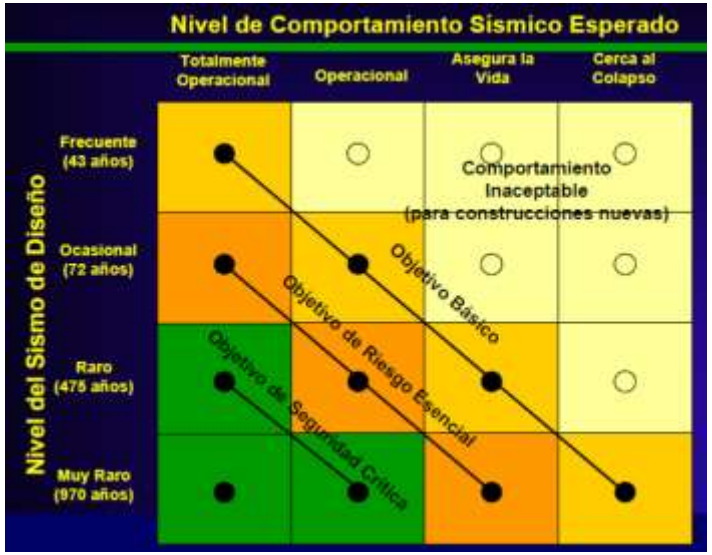
FUNDACIONES, COLUMNAS, DINTELES Y ESTRIBOS PREFABRICADOS, ENSAMBLADOS IN SITU

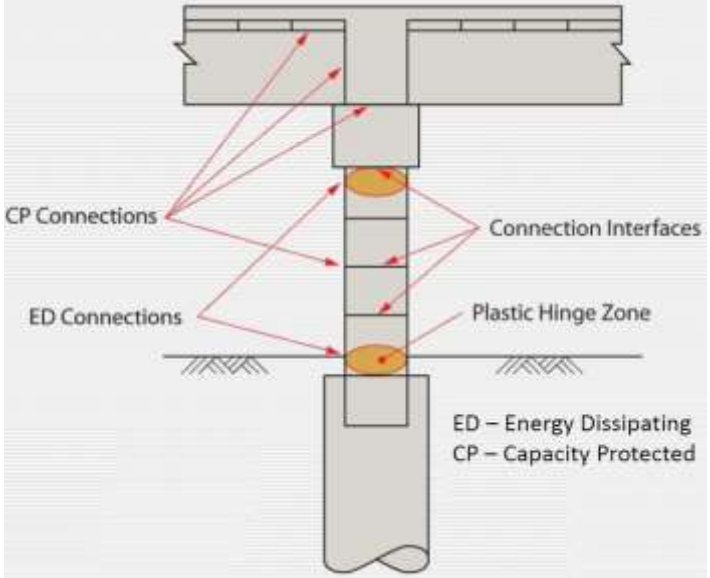


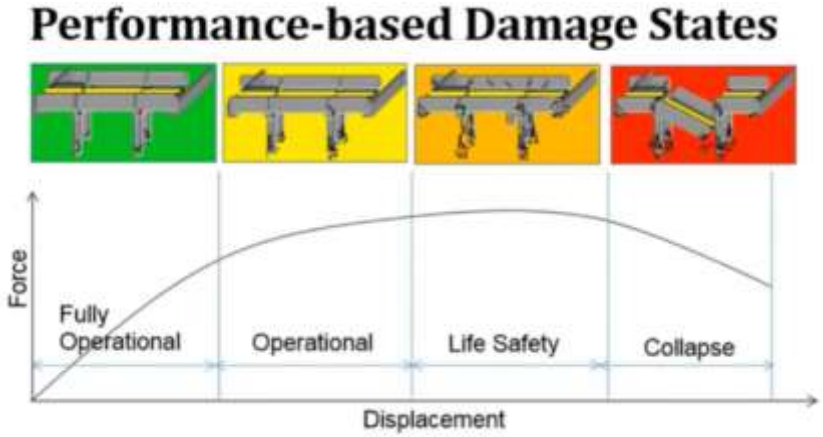


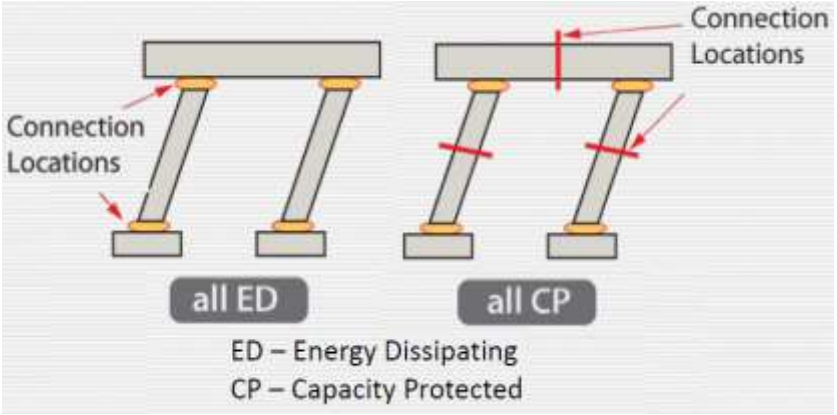
CICLO DE SEMINARIOS WEB

DESARROLLOS Y CONCEPTOS DE PBESs PARA EL DISEÑO SÍSMICO BASADO EN LA PERFORMANCE. GENERACIÓN DE "FUSIBLES" Y ZONAS PROTEGIDAS, EN LAS CONEXIONES





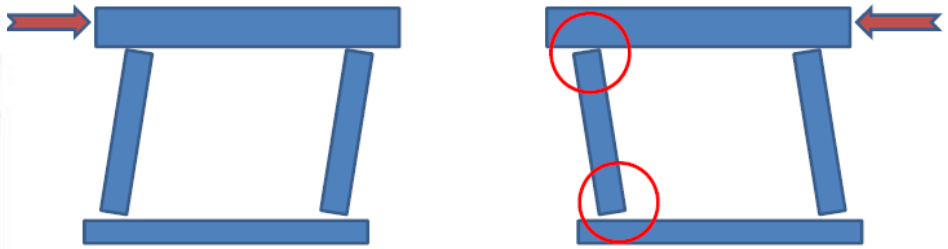




CONEXIONES (FUSIBLES):

- UHPC / ECC
- SUPERELASTIC SHAPE MEMORY ALLOY (SMA)
- SELF-CENTERING COLUMNS

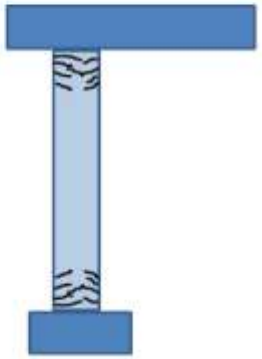
- ABC relies on precast members that are connected in the field.



Seismic Performance Requirements for Bridges (cast-in-place or precast)

- No collapse under strong earthquakes
- Plastic hinging of columns- structural fuse
- Capacity-protected cap beams and footings

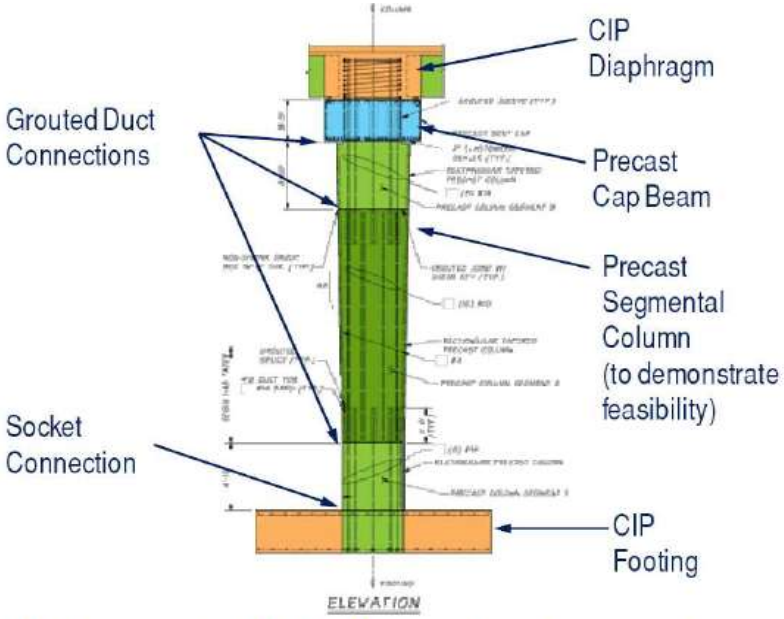
- ABC connections must ensure
  - Column plastic hinging
  - No damage to cap beams and footings



CICLO DE
SEMINARIOS WEB

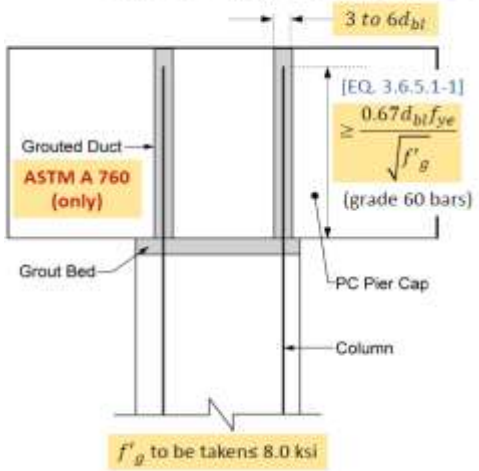
CONEXIONES IN SITU - PBESs

- Mechanical bar connectors
- Grouted duct connections
- Pocket connections
- Socket connections
- Two-stage integral pier cap



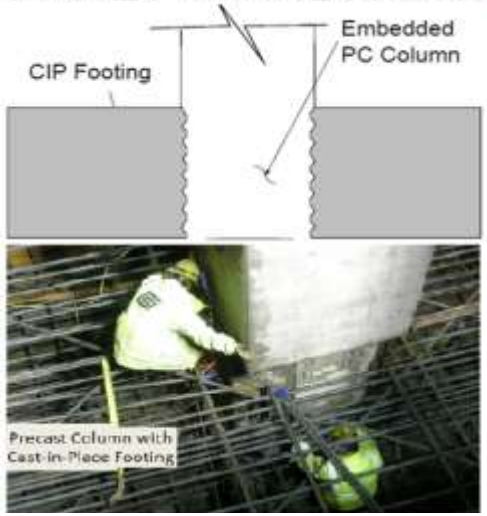
Highways for LIFE Precast bent concept for seismic regions after NCHRP Report 698

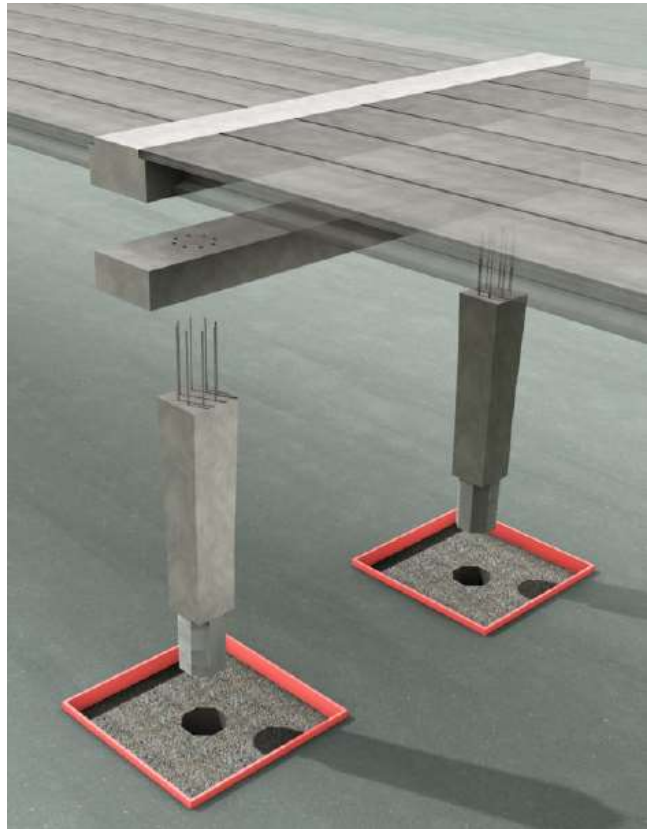
GROUTED DUCT CONNECTIONS

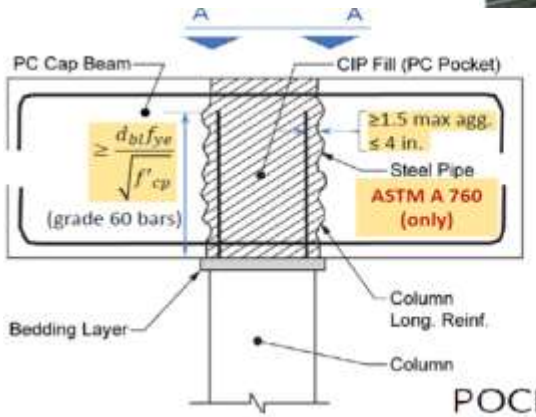


Source: Brenes (2006)

SOCKET CONNECTIONS



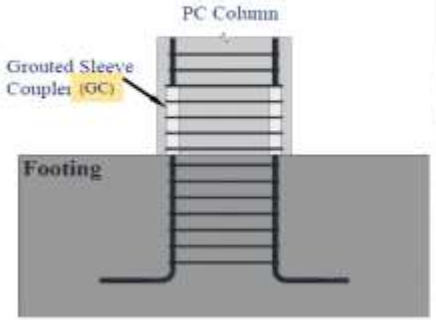




SECTION A-A

POCKET CONNECTIONS

Mechanical Bar Connectors



Note: No more than one connector per bar in plastic hinge zone is allowed (3.6.4.4) so this detail does not meet the GS for ABC.

CICLO DE
SEMINARIOS WEB

PERFORMANCE SÍSMICA - INNOVACIONES

SHAPE MEMORY ALLOY

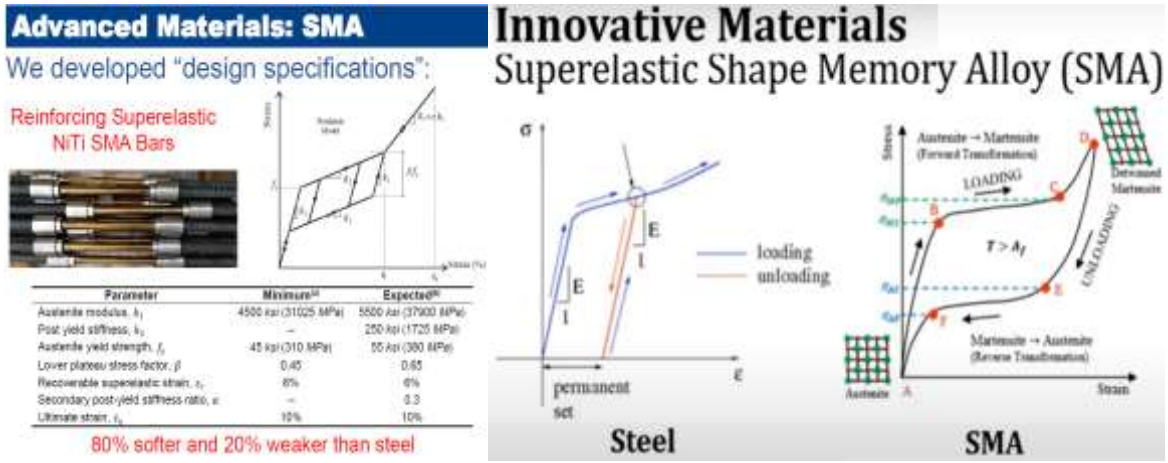


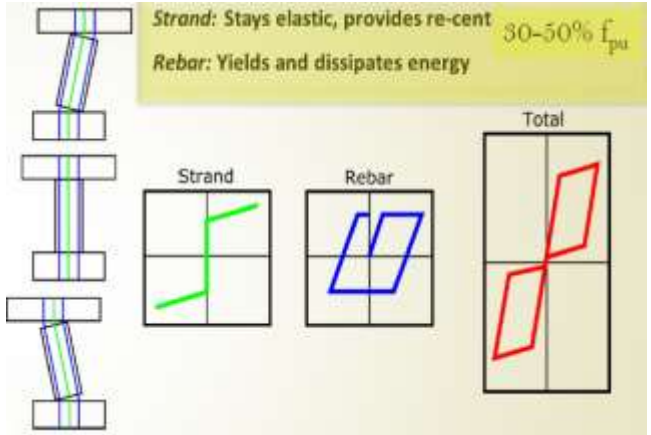
Table 1. Seismic performance strategies for connections.

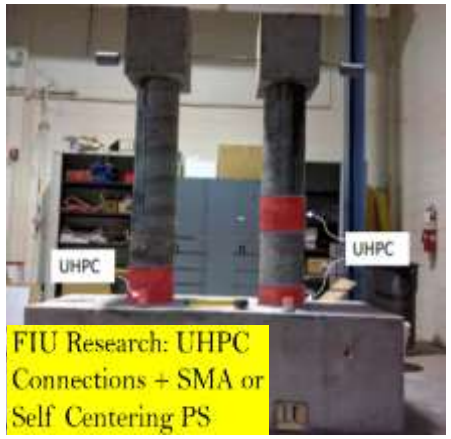
Seismic Performance Strategy	Performance Behavior
Capacity-Protected (CP) Connections	CP elements provide a cyclic strength that is higher than the strength of the adjacent bridge members, allowing the connection to remain essentially elastic with minimal or no damage. As a result, the inelastic deformations are forced to occur in the adjacent elements.
Energy-Dissipating (ED) Connections	ED elements provide a cyclic strength that is lower than that of the adjacent members, thereby causing the inelastic deformation to occur in the connection, but high enough to dissipate enough energy to contribute usefully to the system damping. The deformation capacity is high enough to satisfy the demands associated with the seismic zone in which the bridge is built. The connection may suffer damage, but the consequent strength loss must be acceptable in all degrees of freedom, including both the primary one in which the inelastic deformation occurs and others in which minimal deformation is expected.
Deformation Elements (DE)	DE have little or no strength in the degree of freedom in which the deformation occurs. The deformation capacity is high enough to satisfy the demands associated with the seismic zone in which the bridge is built. The connection protects the adjacent bridge members by concentrating seismic deformation within the connection region but typically provides negligible energy dissipation. The deformation may be free (e.g., a pin), elastic (e.g., an elastomeric pad), or inelastic. Seismic isolation bearings may provide both large deformation capabilities and significant energy dissipation.

Strength Relative to Adjacent Members	High	Capacity Protected		
	Moderate	Not Permitted	Energy Dissipating (Moderate Seismic)	Energy Dissipating (High Seismic)
	Low	Not Permitted	Deformable (Low Seismic)	Deformable (High Seismic)
		Low	Moderate	High
		Deformability		

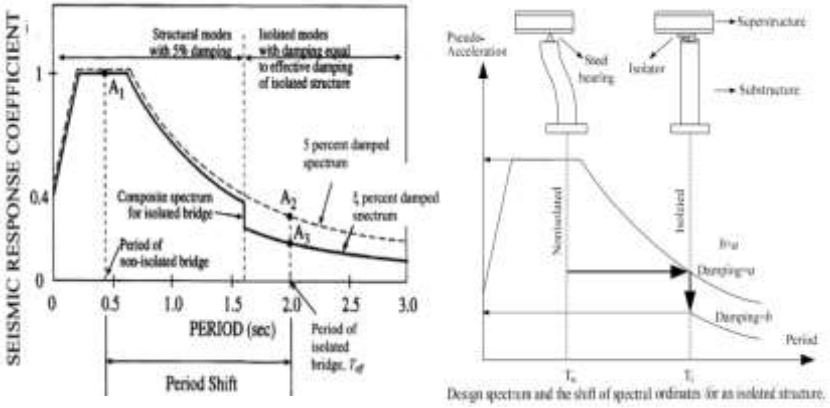
Seismic performance of connection elements in relation to cyclic strength and deformability and their application for moderate and high seismic zones.

SELF-CENTERING COLUMN





AISLADORES SÍSMICOS

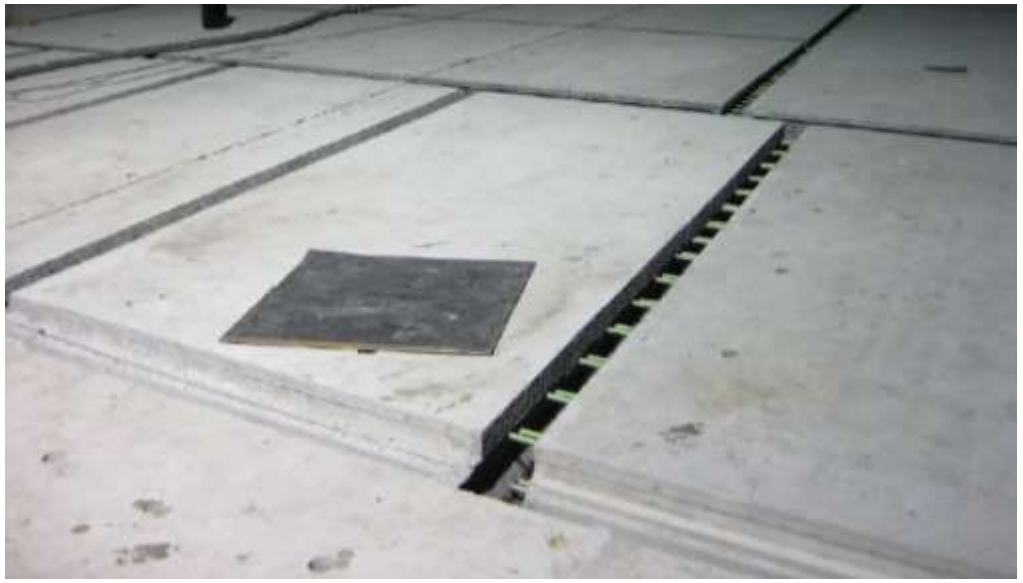


CICLO DE
SEMINARIOS WEB

VIGAS DE ACERO O DE HORMIGÓN PREFABRICADAS

PANELES DE ESPESOR TOTAL O PARCIAL PARA LA EJECUCIÓN DE LA LOSA DEL TABLERO.

CICLO DE
SEMINARIOS WEB

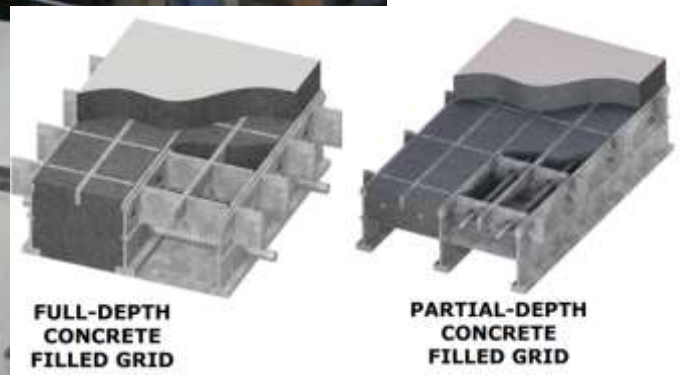


Precast Deck Panel with Integral Barriers
(source: Utah DOT)

CICLO DE SEMINARIOS WEB

OTROS TIPOS DE PANELES PARA TABLERO

ENREJADO DE ACERO RELLENOS CON HORMIGÓN (*CONCRETE FILLED STEEL GRID*)



ENREJADO DE ACERO ABIERTO (*OPEN STEEL GRID*).

PANEL ORTOTRÓPICO DE ACERO O ALUMINIO

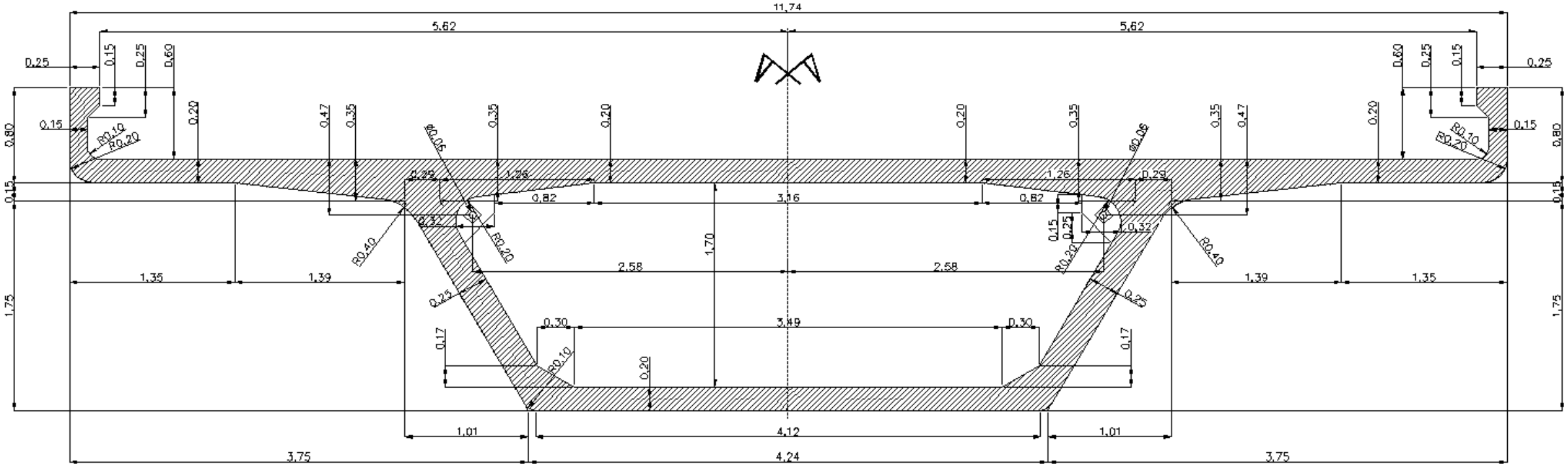
CICLO DE
SEMINARIOS WEB

VIADUCTO FERROVIARIO MITRE

CIUDAD DE BUENOS AIRES (2019)

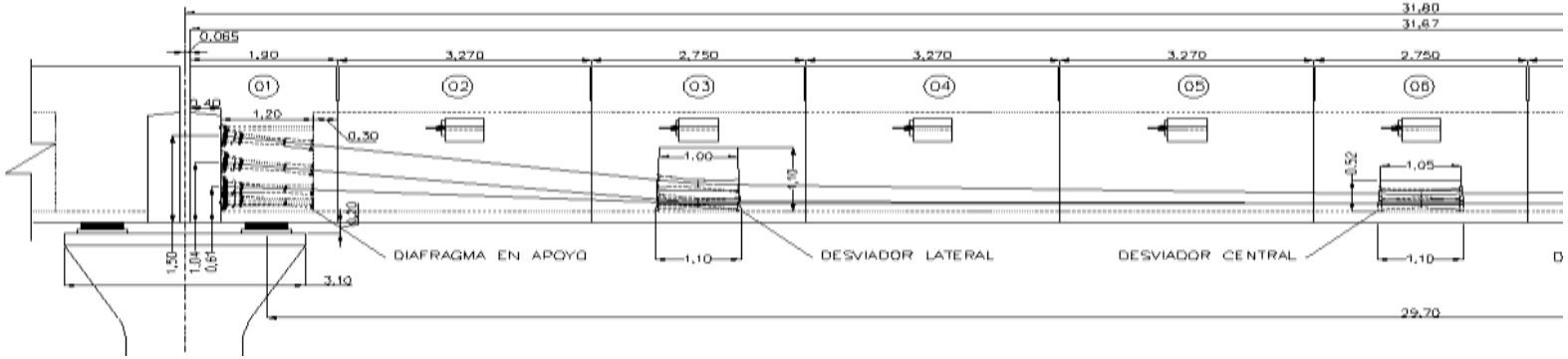
MONTAJE *SPAN BY SPAN*

COMITENTE: MINISTERIO DE TRANSPORTE DE LA NACIÓN – AUSA
CONTRATISTA: ROGGIO – CHEDIACK UTE
PROYECTO EJECUTIVO: EEPP SA
INSPECCIÓN DE OBRA: PEYCO



SECCIÓN DOVELA TÍPICA Y

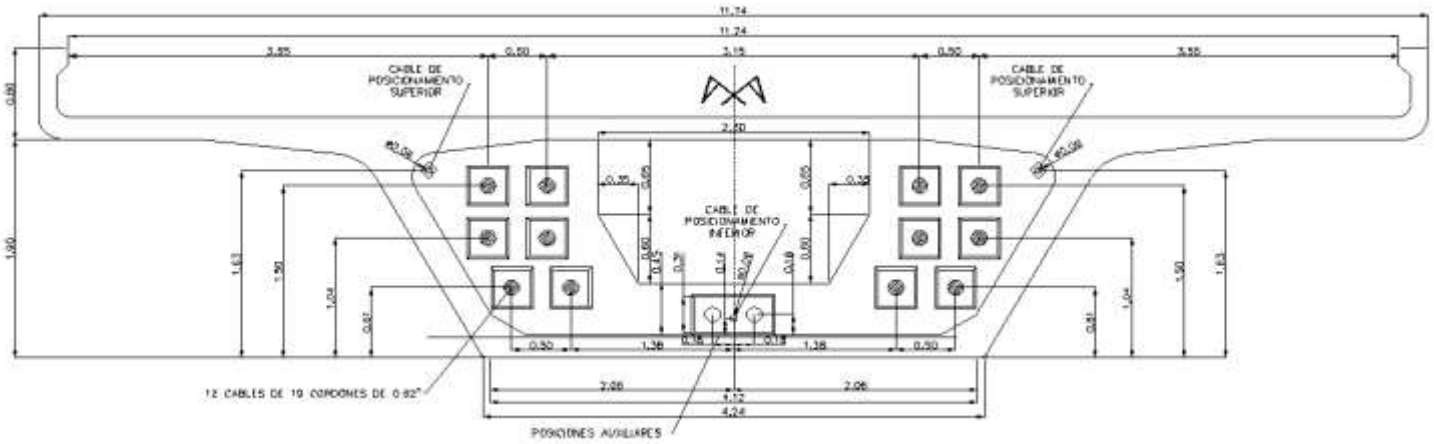
VISTA VIGA CAJÓN TÍPICA



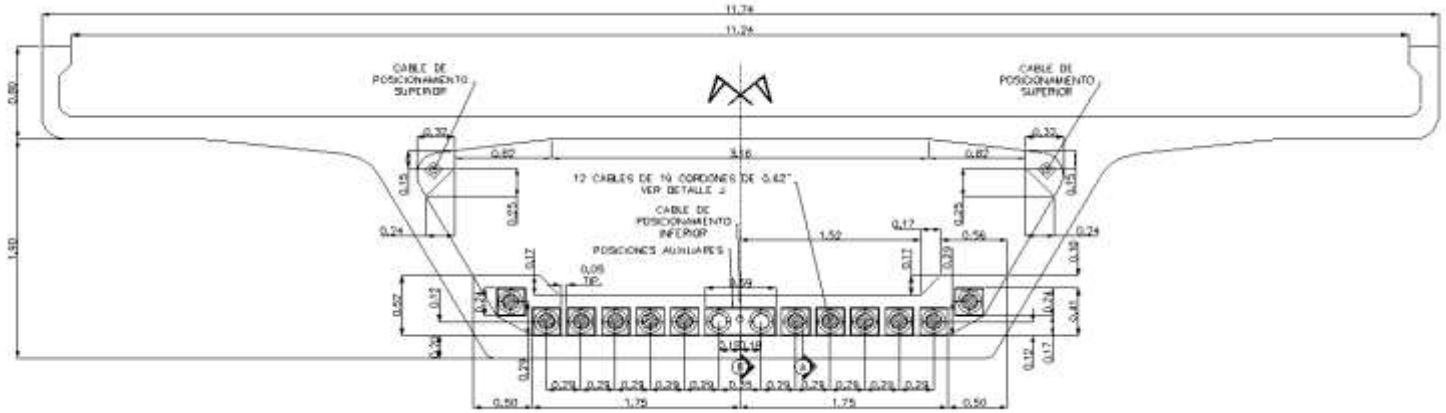
CICLO DE
SEMINARIOS WEB

DIAFRAGMAS

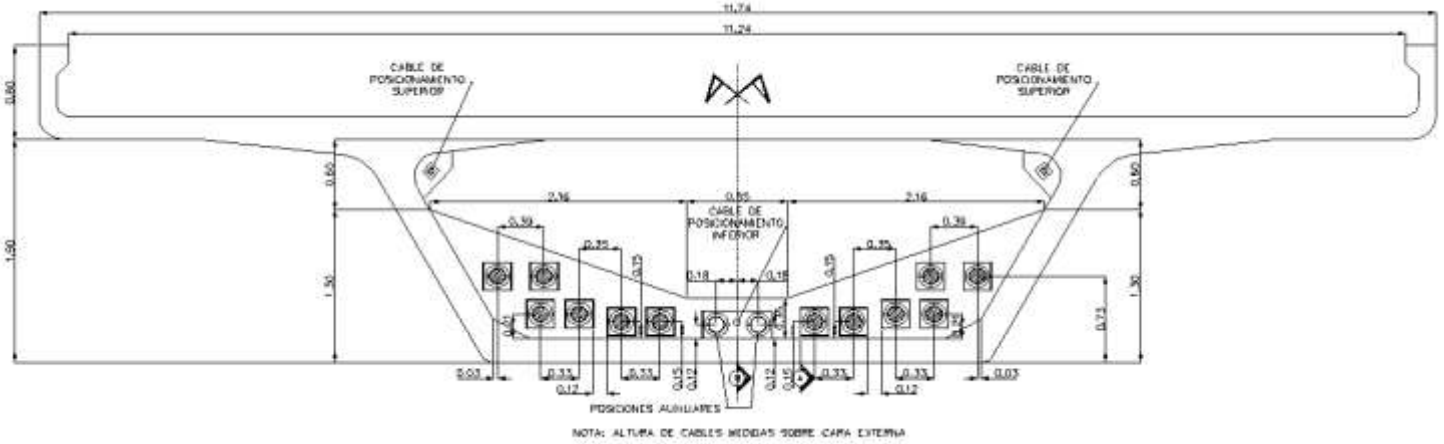
DOVELA TÍPICA



DESVIADOR CENTRAL



DESVIADORES LATERALES

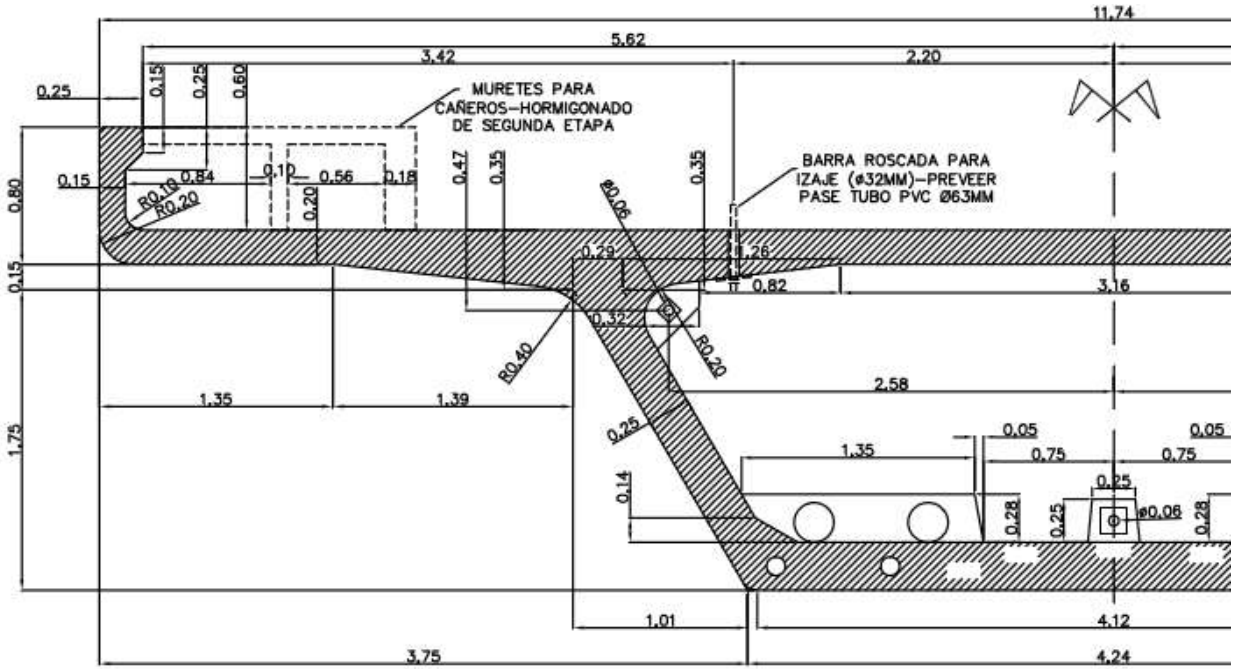


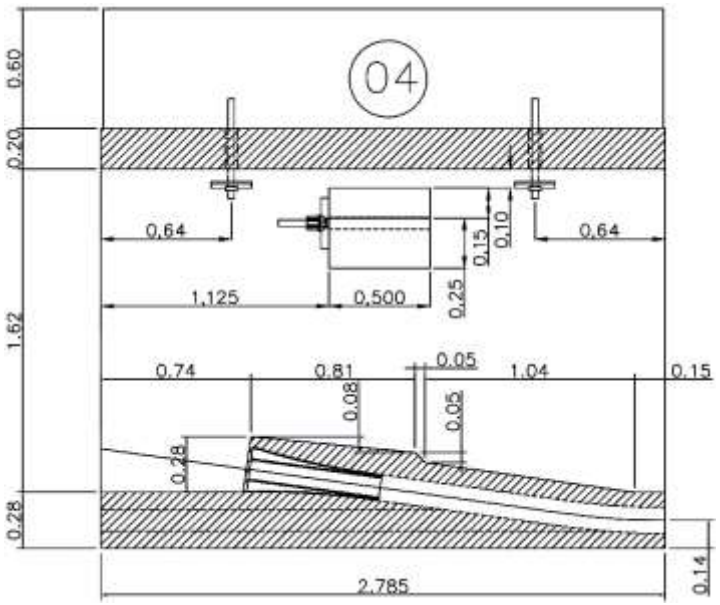
POSTESADO EXTERNO.

H 50 / ADN 420 / C1900 BR

CICLO DE
SEMINARIOS WEB

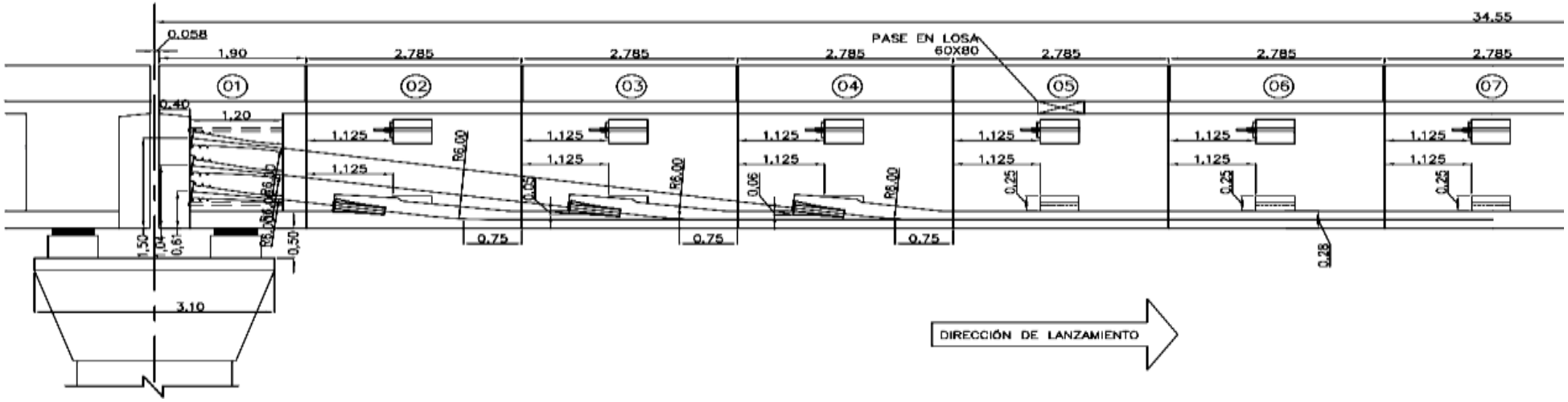
SOLUCIÓN LIBERTADOR





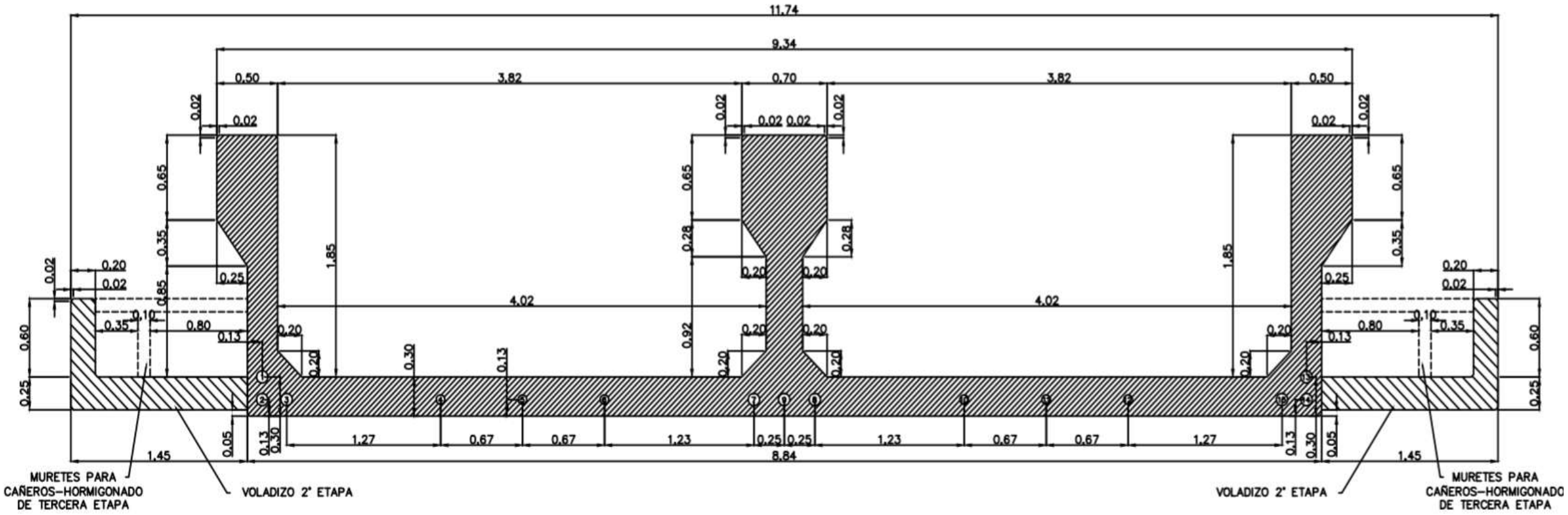
POSTESADO MIXTO

H 50 / ADN 420 / C1900 BR



CICLO DE
SEMINARIOS WEB

SOLUCIÓN VIGA IN SITU DOBLE U O W - MONROE Y ROOSEVELT



POSTESADO INTERNO. H 50 / ADN 420 / C1900 BR

CICLO DE
SEMINARIOS WEB

PILAS TÍPICAS

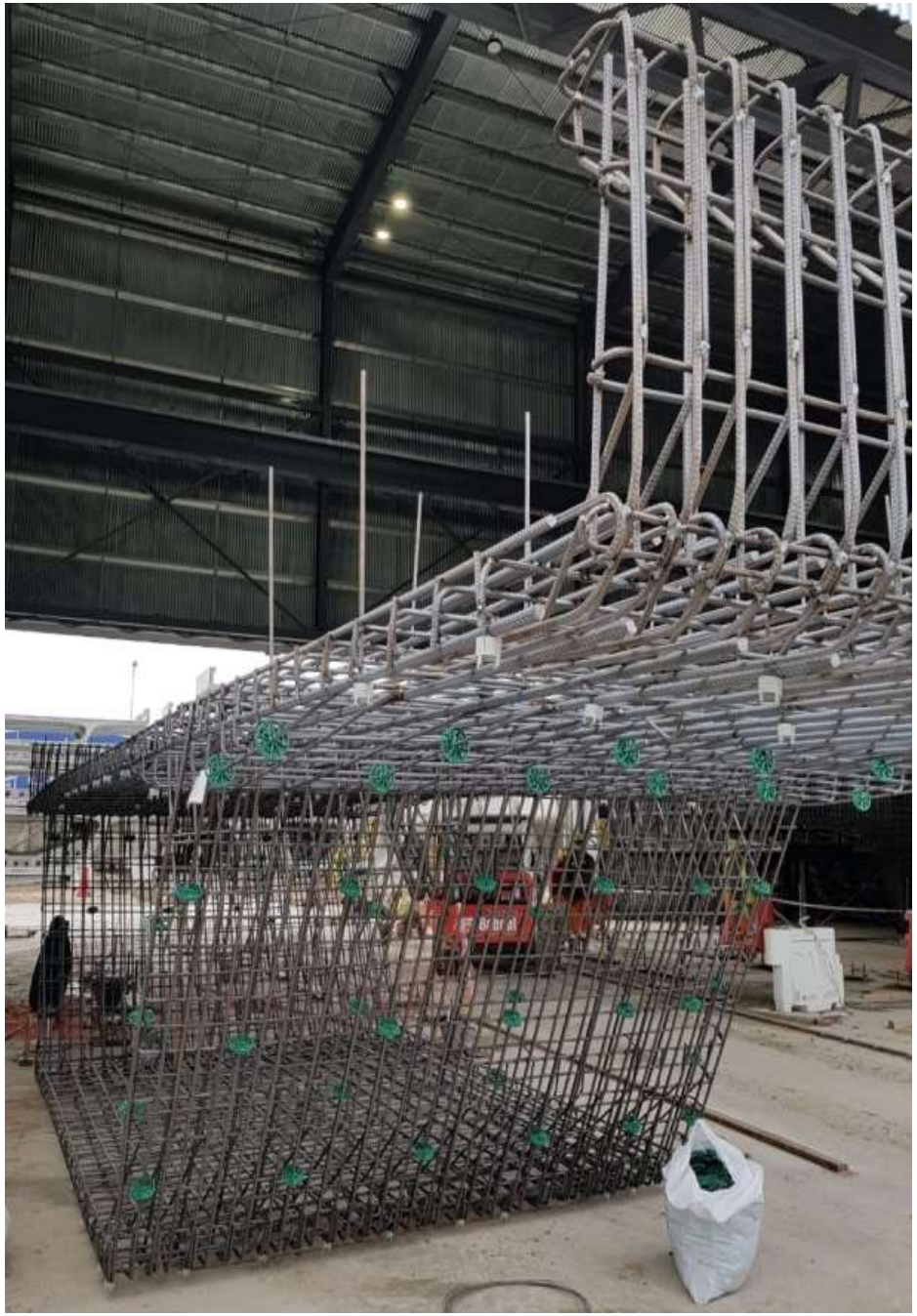
MOLDES EXTERNOS E INTERNOS DE DOVELAS

CONSTRUCCIÓN MEDIANTE SISTEMA DE DOVELA CONJUGADA ASEGURA ENCASTRE. TOTAL DE DOVELAS CONSTRUIDAS: 1017

NAVE DE CONSTRUCCIÓN DE DOVELAS

PLANTA DE ACOPIO

NAVE DE CONSTRUCCIÓN DE DOVELAS



VISTA INTERIOR DE SECCIÓN TÍPICA DESVIADORES LATERALES Y CENTRAL

PUEDE VERSE EL SISTEMA DE ENVAINADO Y BARRAS DE VINCULACIÓN DE USO CONSTRUCTIVO Y PRECOMPRESIÓN

CICLO DE
SEMINARIOS WEB

DOVELA DE PILA

DIAFRAGMAS DE ANCLAJE

SISTEMA DE IZAJE DE DOVELAS

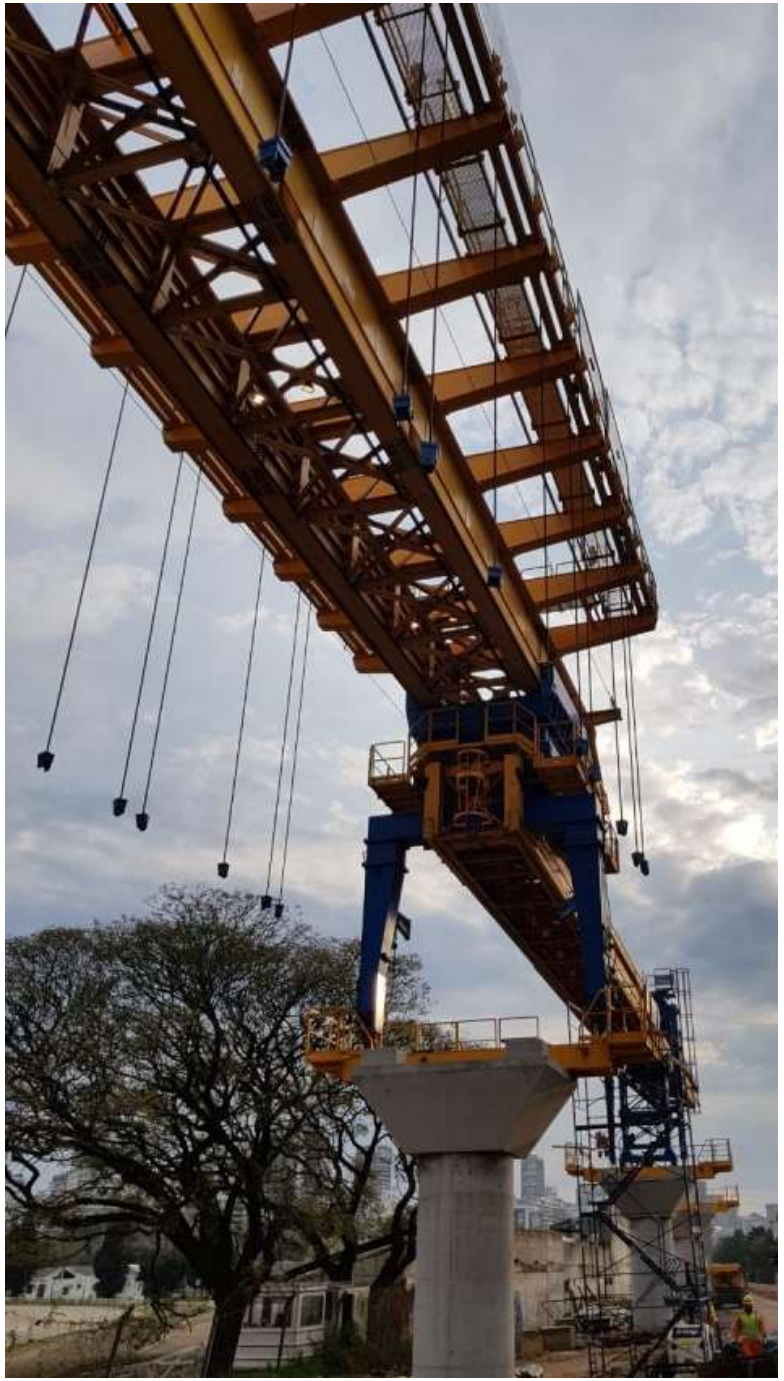
VIGA DE LANZAMIENTO – *SINGLE-GIRDER TELESCOPIC OVERHEAD* SELF LAUNCHING GANTRY CRANE – *SPAN BY SPAN*

AAC
ASOCIACIÓN ARGENTINA DE CARRETERAS

CICLO DE SEMINARIOS WEB

CICLO DE
SEMINARIOS WEB

MONTAJE DE DOVELAS



AAC
ASOCIACIÓN ARGENTINA DE CARRETERAS

CICLO DE SEMINARIOS WEB

VIGA DE LANZAMIENTO 2 - *TWIN-GIRDER OVERHEAD* SELF LAUNCHING GANTRY CRANE – *SPAN BY SPAN*

CICLO DE
SEMINARIOS WEB

DESPLAZAMIENTO DE VÍAS EXISTENTES, PREVIO A LA OBRA, PARA POSIBILITAR EL SERVICIO FERROVIARIO ININTERRUMPIDO DURANTE SU EJECUCIÓN

CICLO DE
SEMINARIOS WEB

VIGAS DOBLE U o W EJECUTADAS IN SITU EN ROOSEVELT Y MONROE POR NECESIDAD DE GÁLIBO BAJO PUENTE

CICLO DE
SEMINARIOS WEB

ESTACIÓN ELEVADA

BELGRANO C.

LONG. APROX. 220 M

CICLO DE
SEMINARIOS WEB

OBRA FINALIZADA

CICLO DE
SEMINARIOS WEB

VIADUCTO FERROVIARIO SAN MARTÍN

CIUDAD DE BUENOS AIRES (2019)

MONTAJE *FULL SPAN*

COMITENTE: MINISTERIO DE TRANSPORTE DE LA NACIÓN – AUSA
CONTRATISTA: GREEN – ROTTIO UTE
PROYECTO EJECUTIVO: EEPP SA
INSPECCIÓN DE OBRA: IATASA – ATEC UTE

CICLO DE
SEMINARIOS WEB

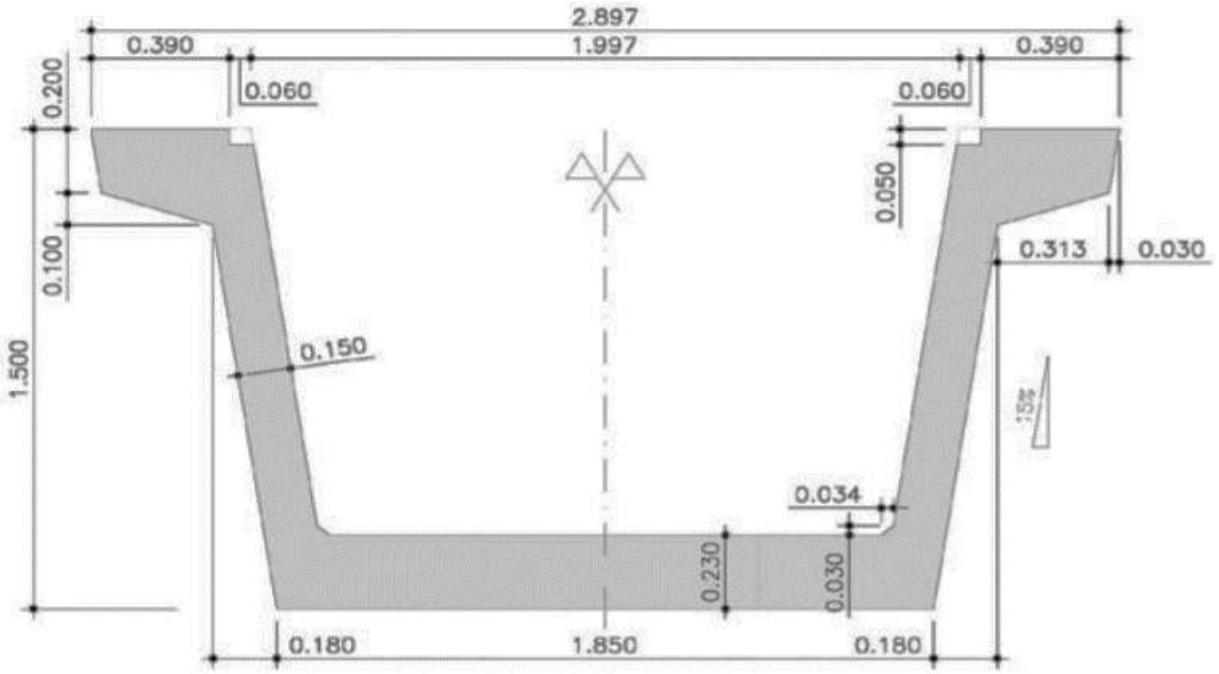
SECCIÓN TÍPICA 1:

UNA VIGA CAJÓN PREMOLDEADA POR VÍA

SECCIÓN: ARTESA + LOSA (PREM.)

PRETENSADO

H 47 / ADN 420 / C1900 BR



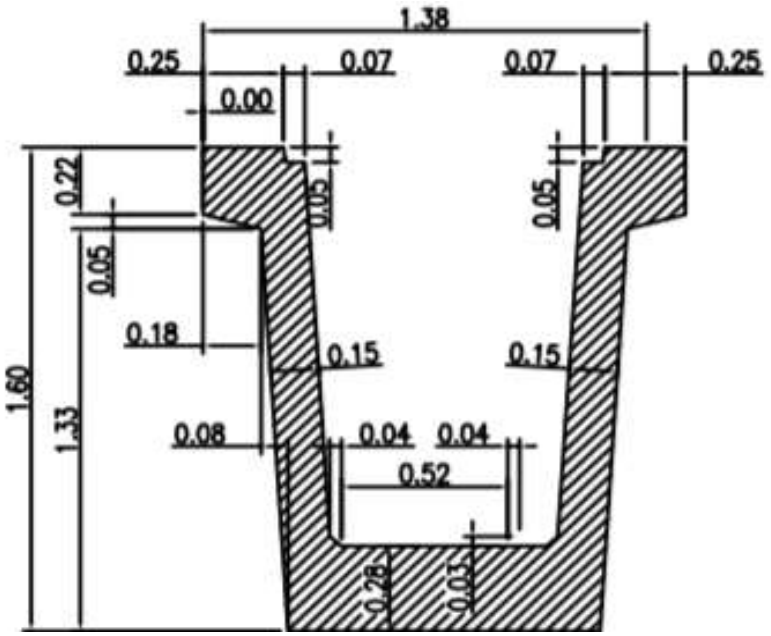
SECCIÓN TÍPICA 2:

DOS VIGAS NABLA PREMOLDEADAS POR VÍA MAS LOSA IN SITU

SECCION: NABLA (PREM.) + LOSA (IN SITU)

PRE Y POSTESADO

H 47 / ADN 420 / C1900 BR



CICLO DE
SEMINARIOS WEB

PILAS TÍPICAS
DE 1 Y 2 VÍAS
DOS VIGAS
NABLA POR VÍA

CICLO DE
SEMINARIOS WEB

PILA TÍPICA DE 3 VÍAS

CICLO DE
SEMINARIOS WEB

ESTACIONES PATERNAL Y VILLA CRESPO

PILAS TÍPICAS DE 3 Y 4 VÍAS

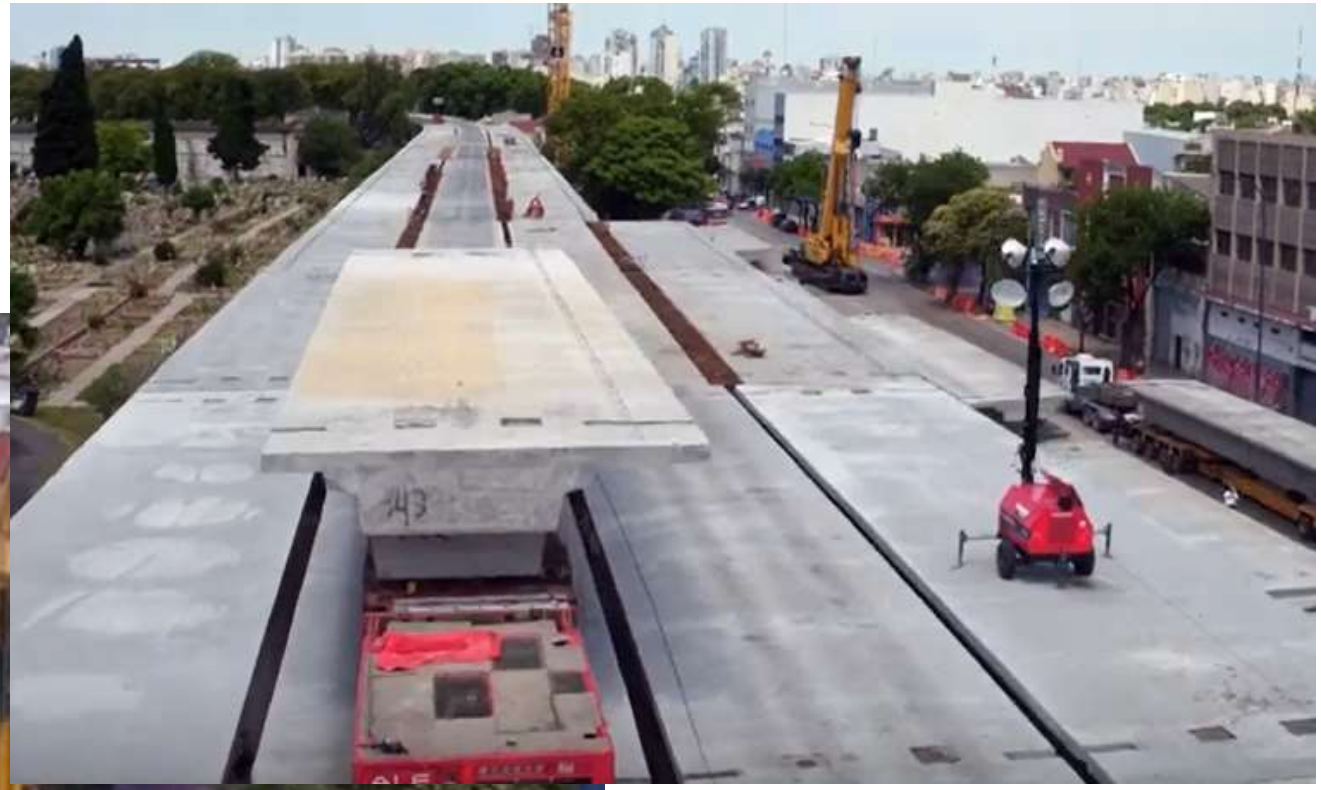
CICLO DE
SEMINARIOS WEB

PLANTA DE VIGAS CAJÓN PRETENSADAS Y PÓTICOS DE IZAJE Y TRANSPORTE

CICLO DE
SEMINARIOS WEB

EQUIPO DE LANZAMIENTO – *FULL SPAN*

CICLO DE
SEMINARIOS WEB



TRANSPORTE DE VIGAS MEDIANTE CARRETÓN AUTOPROPULSADO SPMT (*SELF PROPELLED MODULAR TRANSPORTER*) POR SOBRE VIGAS PREVIAMENTE INSTALADAS

CICLO DE
SEMINARIOS WEB

UNA VEZ QUE EL SPMT LLEGA AL LUGAR DE MONTAJE, LA VIGA CAJÓN ES IZADA POR EL EQUIPO LANZADOR Y UBICADA EN EL LUGAR CORRESPONDIENTE

EL EQUIPO PERMITE DESPLAZAMIENTOS LATERALES DE LA PIEZA

CICLO DE
SEMINARIOS WEB

MONTAJE DE VIGAS “ESPECIALES” 39 M DE LUZ, MEDIANTE MEGALIFT

CICLO DE
SEMINARIOS WEB

EJECUCIÓN DE LOSA DE TABLERO IN SITU, SOBRE VIGAS NABLA

OBRA FINALIZADA

GRACIAS POR SU ATENCIÓN