



**INTERNATIONAL PRESTRESSED HOLLOW CORE ASSOCIATION**  
**TECHNICAL SEMINAR**

***Design of deep hollow core sections***

***Bruno Della Bella - Precompressi Centro Nord (Italy)***

***Leuven, 25 - 26 September 2003***

# ***Design of deep hollow core sections***

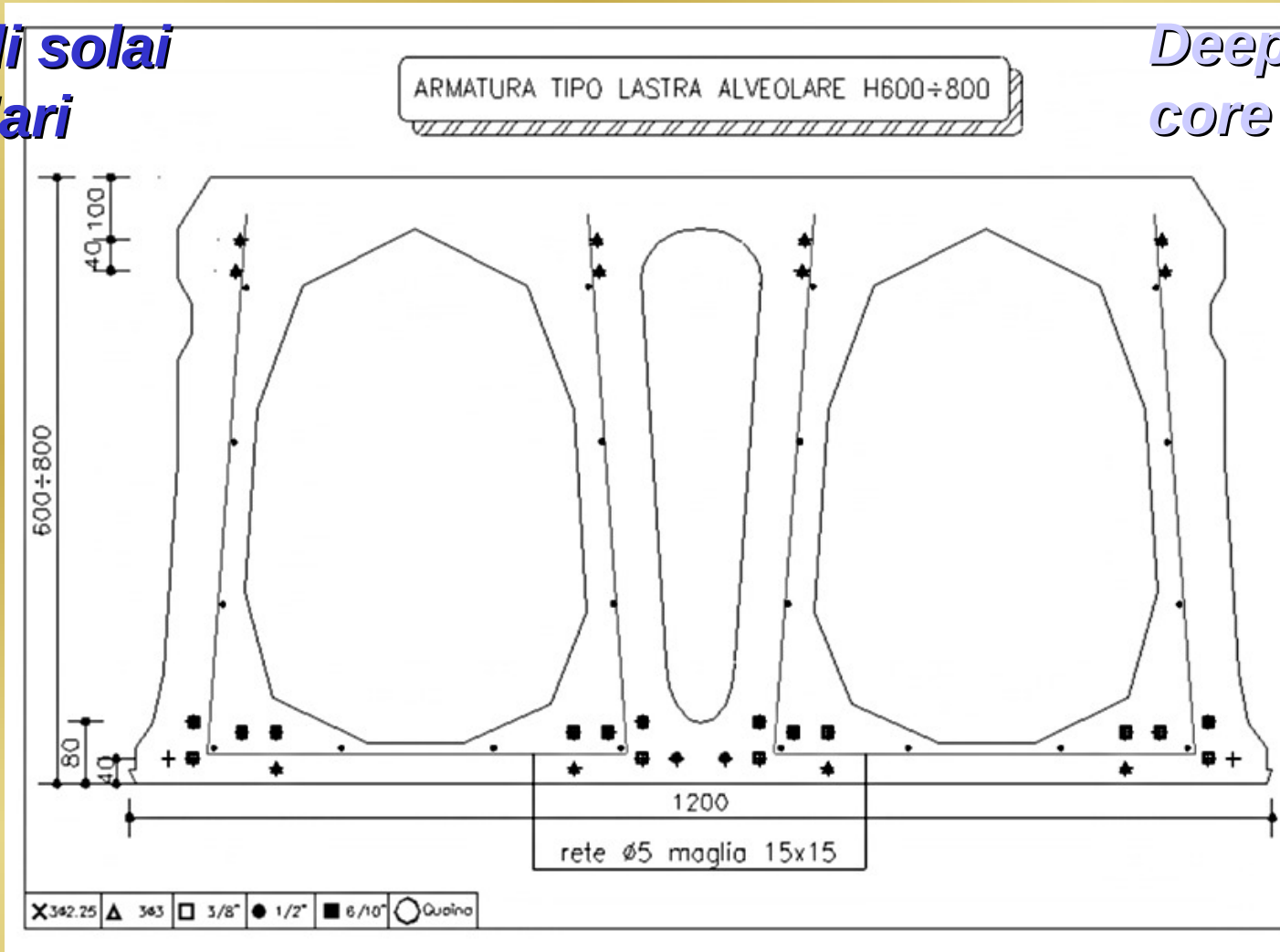
## **SUMMARY**

- ***Manufacturing technology***
- ***Section characteristics and reinforcement***
- ***Applications and construction details***
- ***Normative and design references***

# ***Tecnologia produttiva    Manufacturing technology***

***Grandi solai  
alveolari***

***Deep hollow  
core slabs***



***Armatura taglio nelle nervature e all'intradosso***  
***Shear reinforcement of webs and bottom flange***

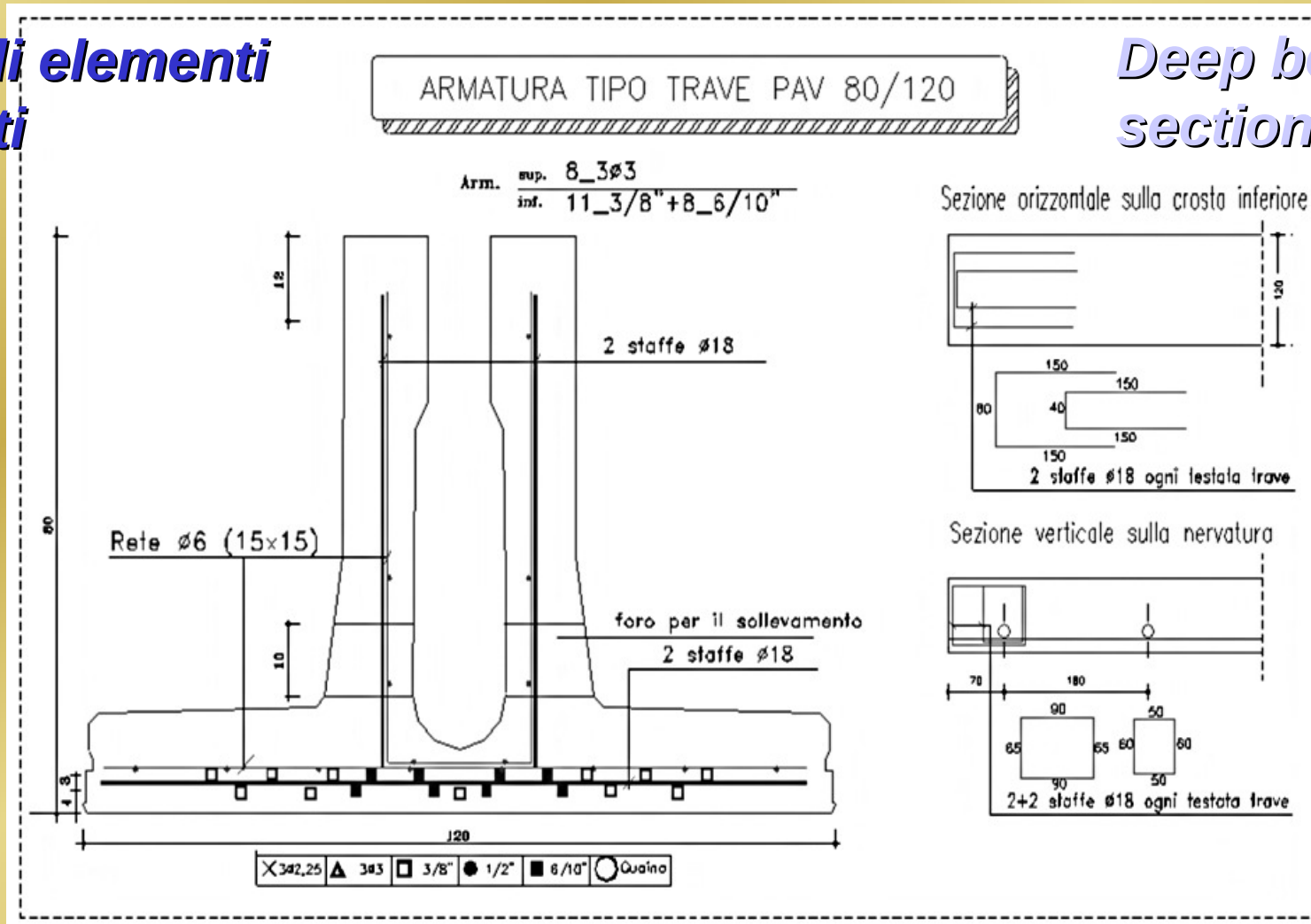


**GRUPPO  
CENTRO  
NORD**

# ***Tecnologia produttiva    Manufacturing technology***

***Grandi elementi  
nervati***

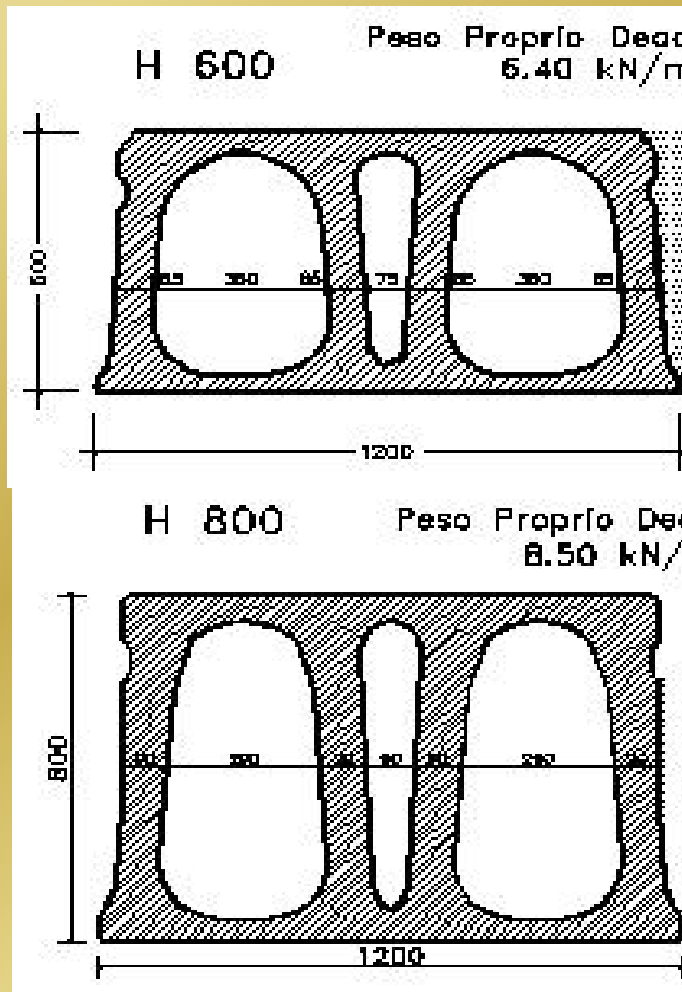
***Deep beam  
sections***



***Armatura taglio nelle nervature e all'intradosso***  
***Shear reinforcement of webs and bottom flange***



# ***Tecnologia produttiva    Manufacturing technology***



***Produzione di grandi solai alveolari***  
***Deep hollow core slide forming in progress***

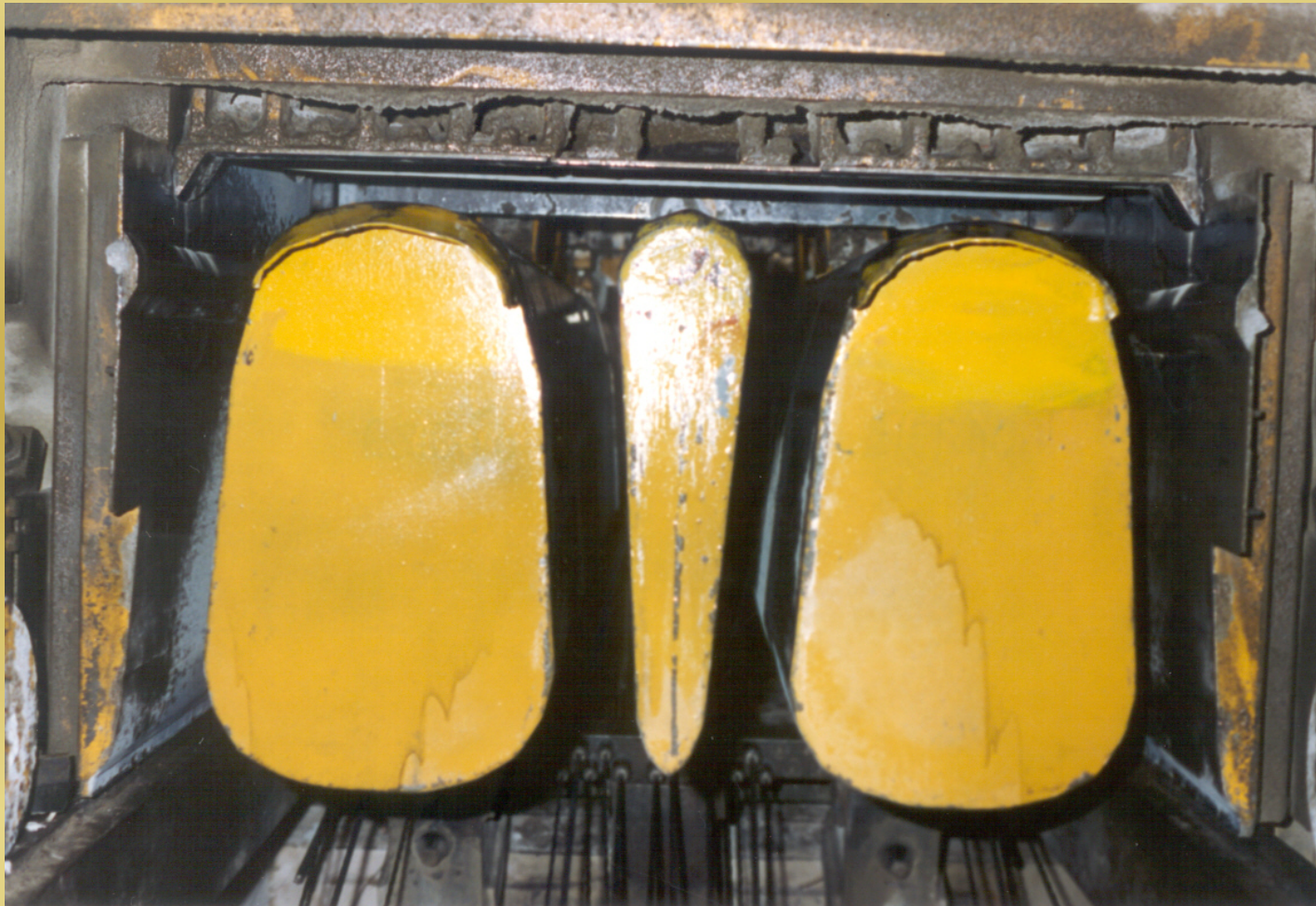


# ***Tecnologia produttiva    Manufacturing technology***



***Macchina vibrofinitrice per grandi alveolari***  
***Vibrofinishing machine for deep hollow core***

# ***Tecnologia produttiva    Manufacturing technology***



***Vista macchina dai tubi formatori***

***Sight of Vibrofinishing machine from the back***



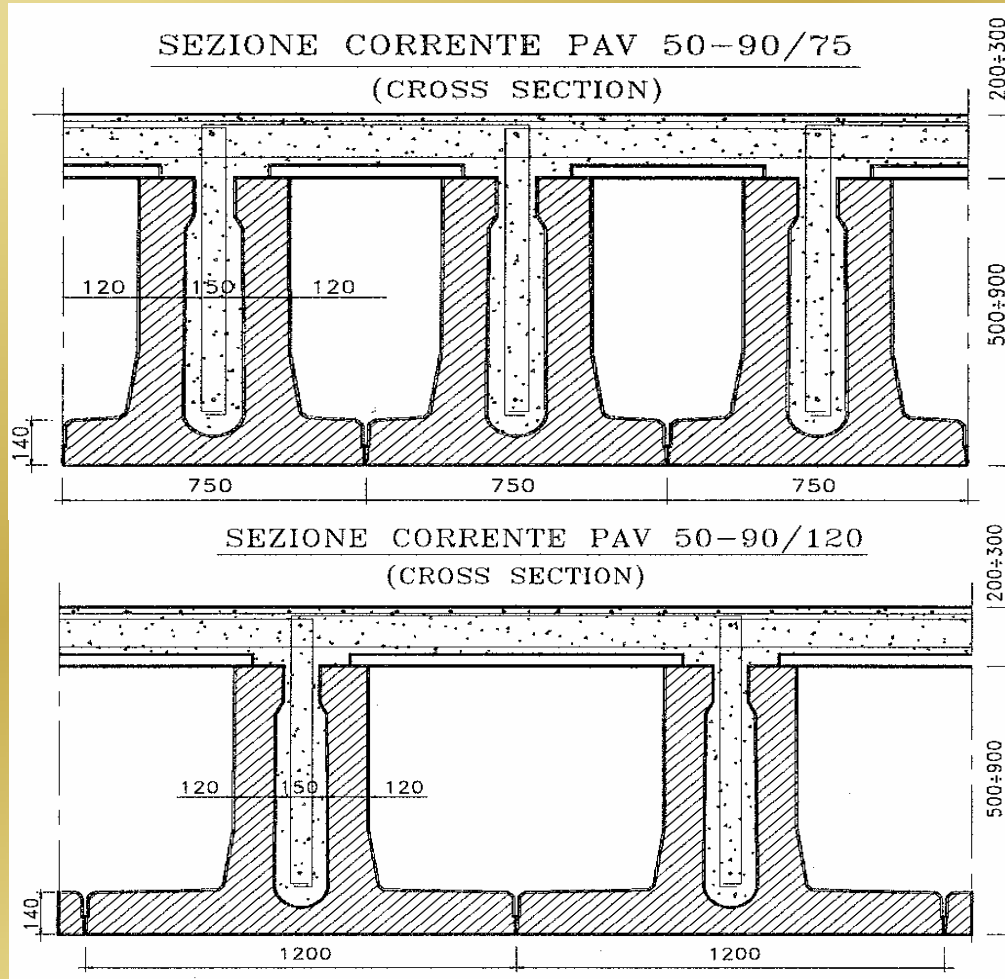
# ***Tecnologia produttiva    Manufacturing technology***



***Taglio pannelli con disco speciale da 1800 mm***  
***Cutting operation with saw disk of 1800 mm***



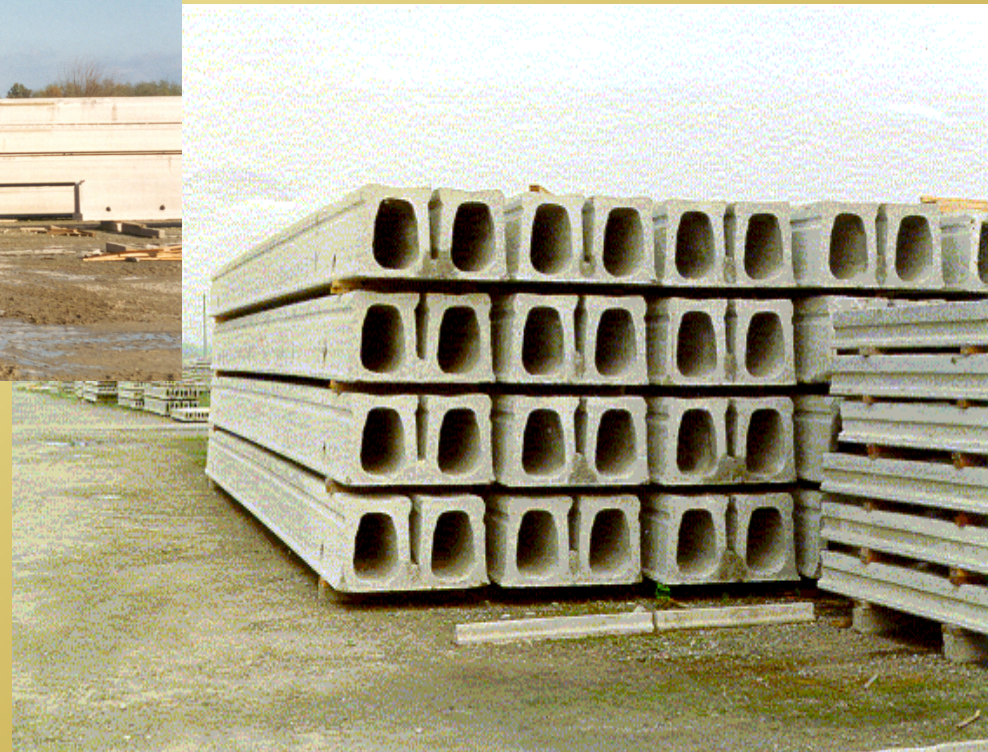
# ***Tecnologia produttiva***    ***Manufacturing technology***



***Produzione di grandi elementi nervati***  
***Deep beam sections slide forming in progress***



# ***Tecnologia produttiva    Manufacturing technology***



***Carico e stoccaggio alveolari H 600 L 18 mt.***  
***Loading and storage deep H.C. H 600 L 18 m.***



## ***Caratteristiche della sezione e armature***



## ***Section characteristics and reinforcement***

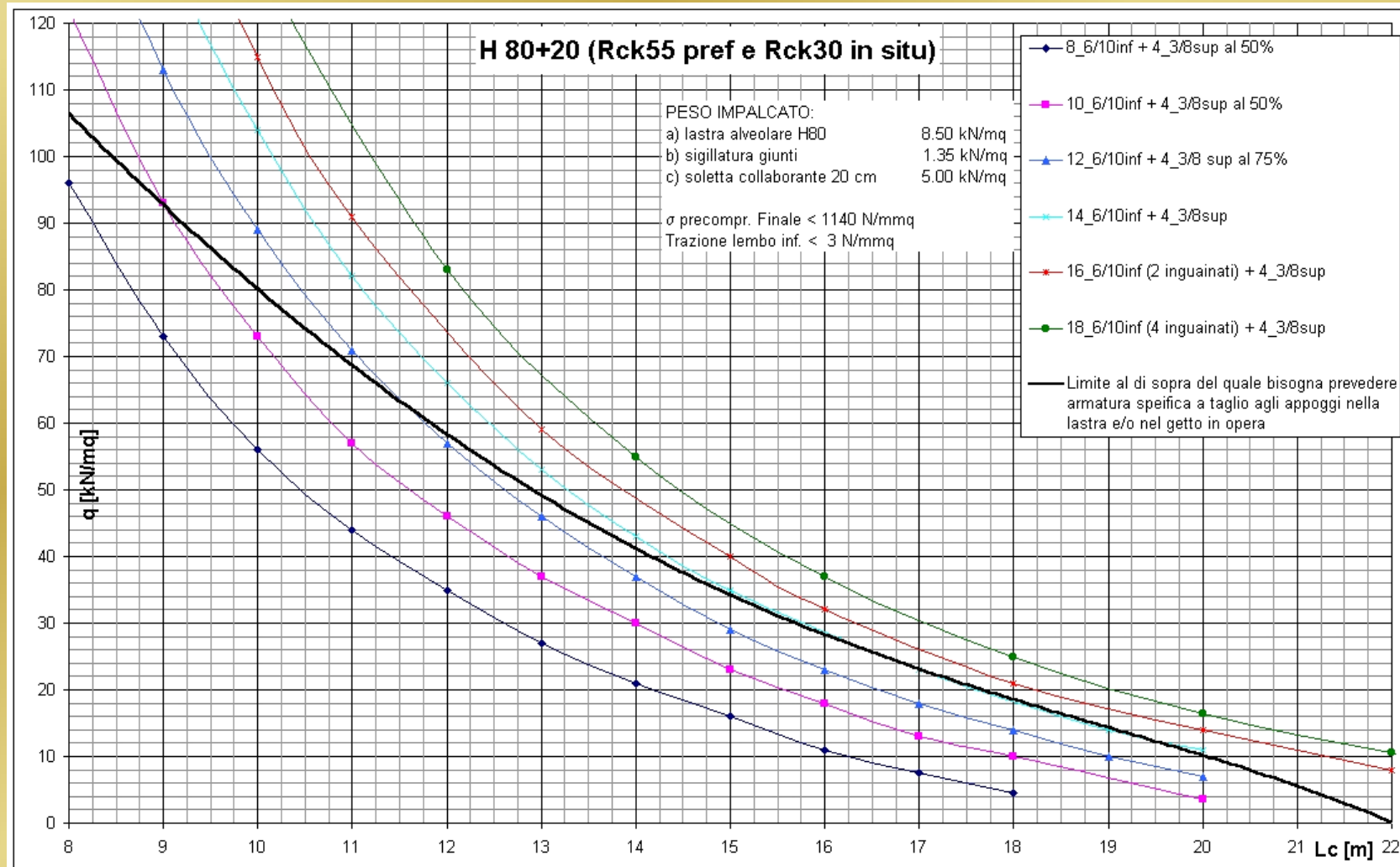


***Armatura a taglio continua e specifica all'appoggio***

***Continuous and specific shear reinforcement***

# Caratteristiche della sezione e armature

# Section characteristics and reinforcement



**Diagramma luce-sovraccarico alveolare H 800**  
**Load-span diagram of deep H.C. slab H 800**

## ***Caratteristiche della sezione e armature***

## ***Section characteristics and reinforcement***

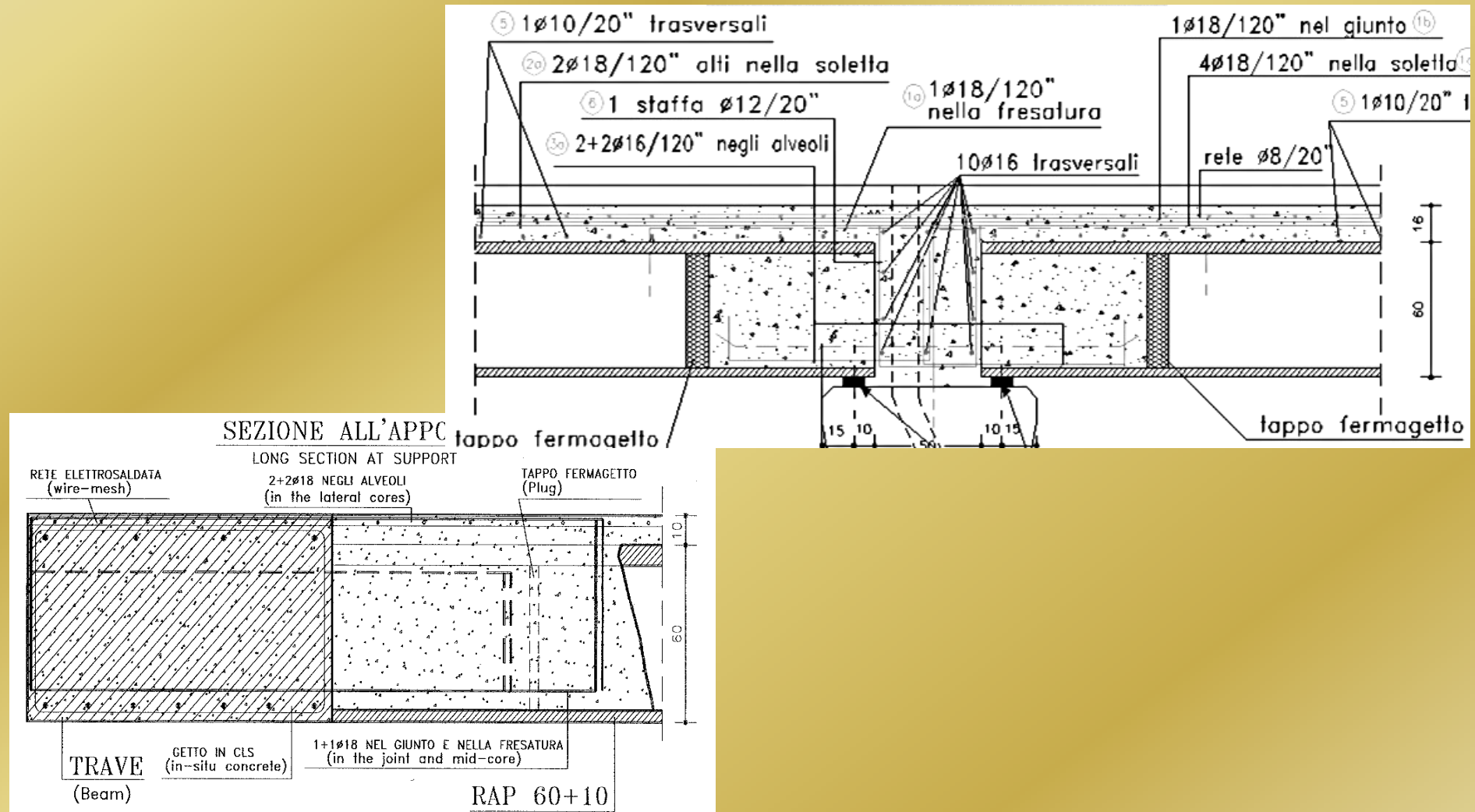


***Travi PAV con lamiere grecate per il getto***

***Beam element with corrugated plates for topping***

## Caratteristiche della sezione e armature

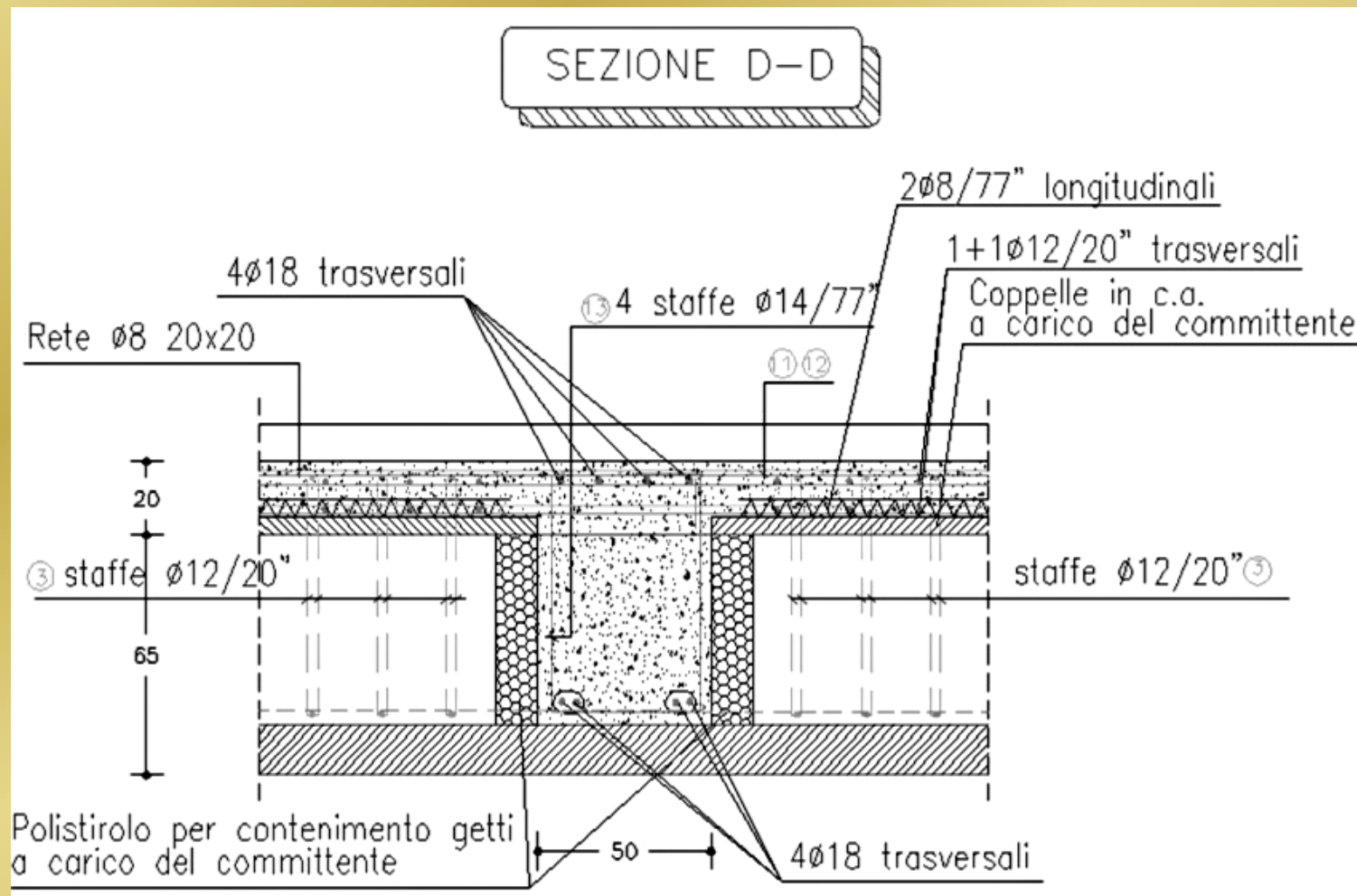
## Section characteristics and reinforcement



**Alveolari in luce netta e in continuità**  
**H.C. composite connection and in continuity**

## ***Caratteristiche della sezione e armature***

## ***Section characteristics and reinforcement***



***Dettaglio del traverso intermedio***  
***Mid-span transverse reinforcement***

**GRANDI SOLAI IN EDILIZIA**

**Esempi applicativi e  
dettagli costruttivi**

**DEEP H.C. FOR BUILDING**

**Construction examples  
and detailing**



**Istituto BVM - Merate**

**Edificio scolastico di 3 piani L 20 mt sovr. 650 kN/mq REI 120**  
**3 story school span 20 m, load 6.50 kN/mq REI 120**



## GRANDI SOLAI IN EDILIZIA

*Esempi applicativi e  
dettagli costruttivi*

## DEEP H.C. FOR BUILDING

*Construction examples  
and detailing*



*Vista e pianta solaio auditorium*

*View and floor plan of auditorium*



**Istituto BVM - Merate**

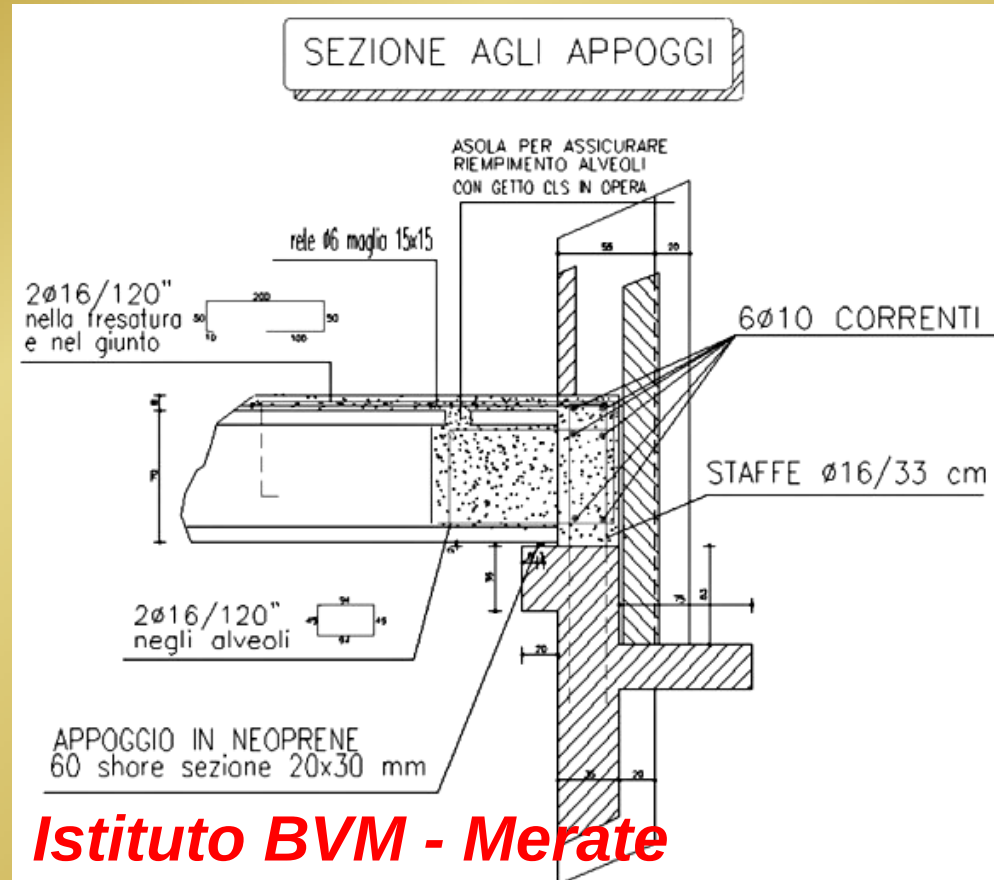
## GRANDI SOLAI IN EDILIZIA

### Esempi applicativi e dettagli costruttivi



## DEEP H.C. FOR BUILDING

### Construction examples and detailing



**Istituto BVM - Merate**

**Solaio in fase di posa e dettaglio all'appoggio**  
**H.C. slabs during erection and detail of support**



**GRANDI SOLAI IN EDILIZIA**

***Esempi applicativi e  
dettagli costruttivi***

**DEEP H.C. FOR BUILDING**

***Construction examples  
and detailing***



**Centro Commerciale - Ravenna**

***Grandi alveolari con travi in opera in spessore***  
***Deep hollow core with cast in-situ shallow beams***



## **GRANDI SOLAI IN EDILIZIA**

***Esempi applicativi e  
dettagli costruttivi***

## **DEEP H.C. FOR BUILDING**

***Construction examples  
and detailing***



***Hotel Dino - Baveno***

***Solaio H 600 L 19 mt per sala congressi in fase di posa***

***Erection of slab H 600 L 19 m for congress hall***

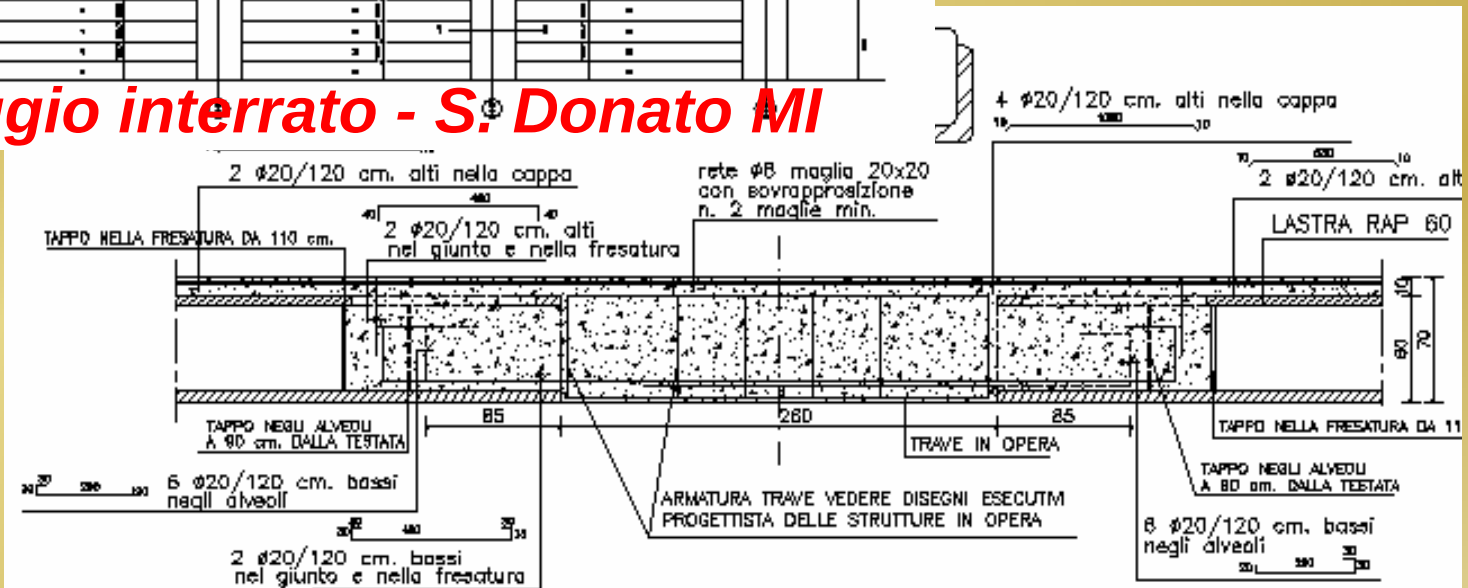


# GRANDI SOLAI IN EDILIZIA

## Esempi applicativi e dettagli costruttivi

# DEEP H.C. FOR BUILDING

## Construction examples and detailing



**Pianta e sezione solaio con travi in spessore**  
**Floor plan and section with cast in-situ beams**

## ***GRANDI SOLAI IN EDILIZIA***

***Esempi applicativi e  
dettagli costruttivi***



## ***DEEP H.C. FOR BUILDING***

***Construction examples  
and detailing***

***Parcheggio interrato - S. Donato MI***



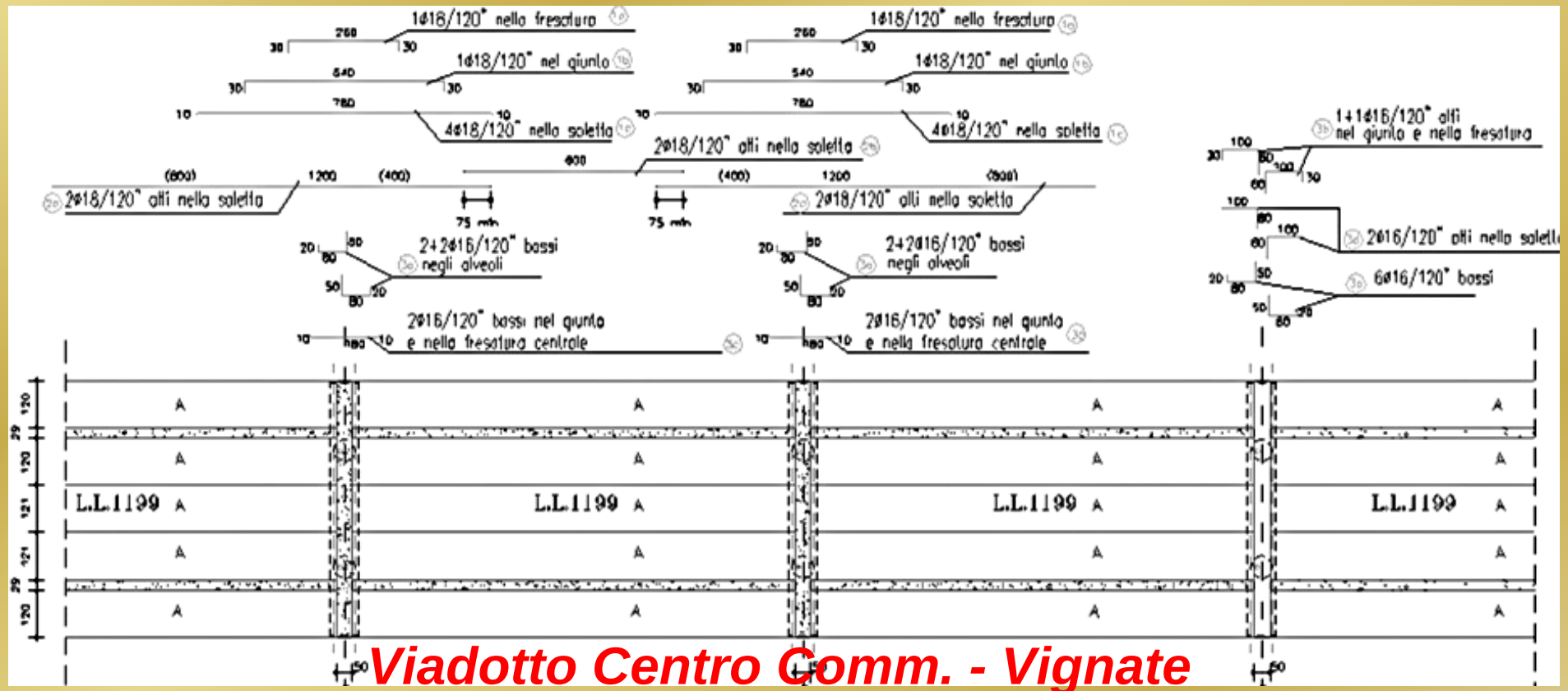
***Vista parcheggio in opera***  
***Views of finished parking***

## IMPALCATI STRADALI

### Esempi applicativi e dettagli costruttivi

## DEEP H.C. FOR BRIDGES

### Construction examples and detailing



**Stralcio pianta viadotto a più campate continue**  
**Floor plan of multi-span viaduct with H.C. slab**



## Esempi applicativi e dettagli costruttivi

# Construction examples and detailing



## ***IMPALCATI STRADALI***

***Esempi applicativi e  
dettagli costruttivi***

## ***DEEP H.C. FOR BRIDGES***

***Construction examples  
and detailing***

***Viadotto Centro Comm. - Vignate***



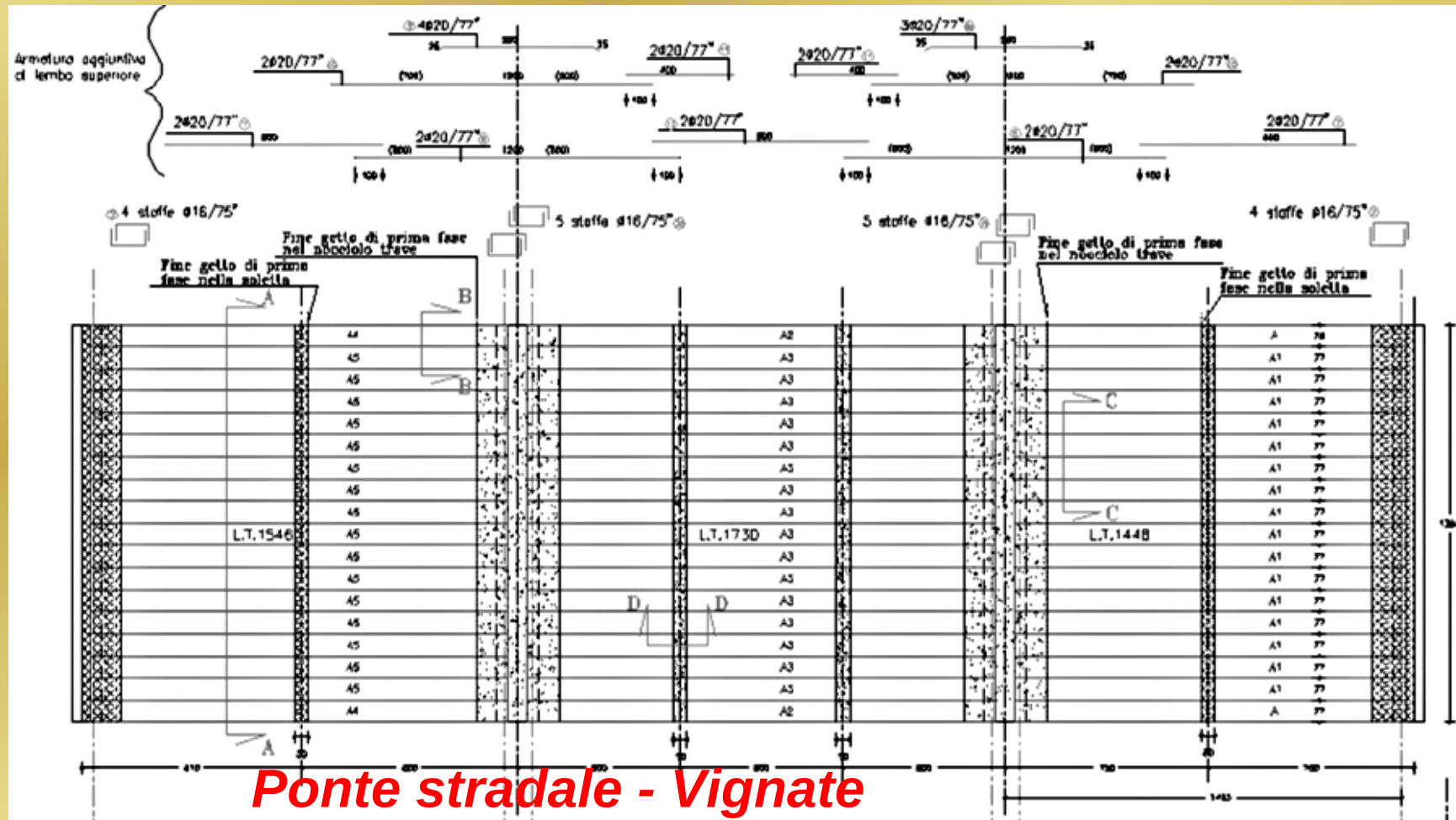
***Vista del viadotto con grandi lastre alveolari***  
***Views of viaduct with deep H.C. slabs***

## IMPALCATI STRADALI

*Esempi applicativi e  
dettagli costruttivi*

## DEEP BEAMS FOR BRIDGES

*Construction examples  
and detailing*



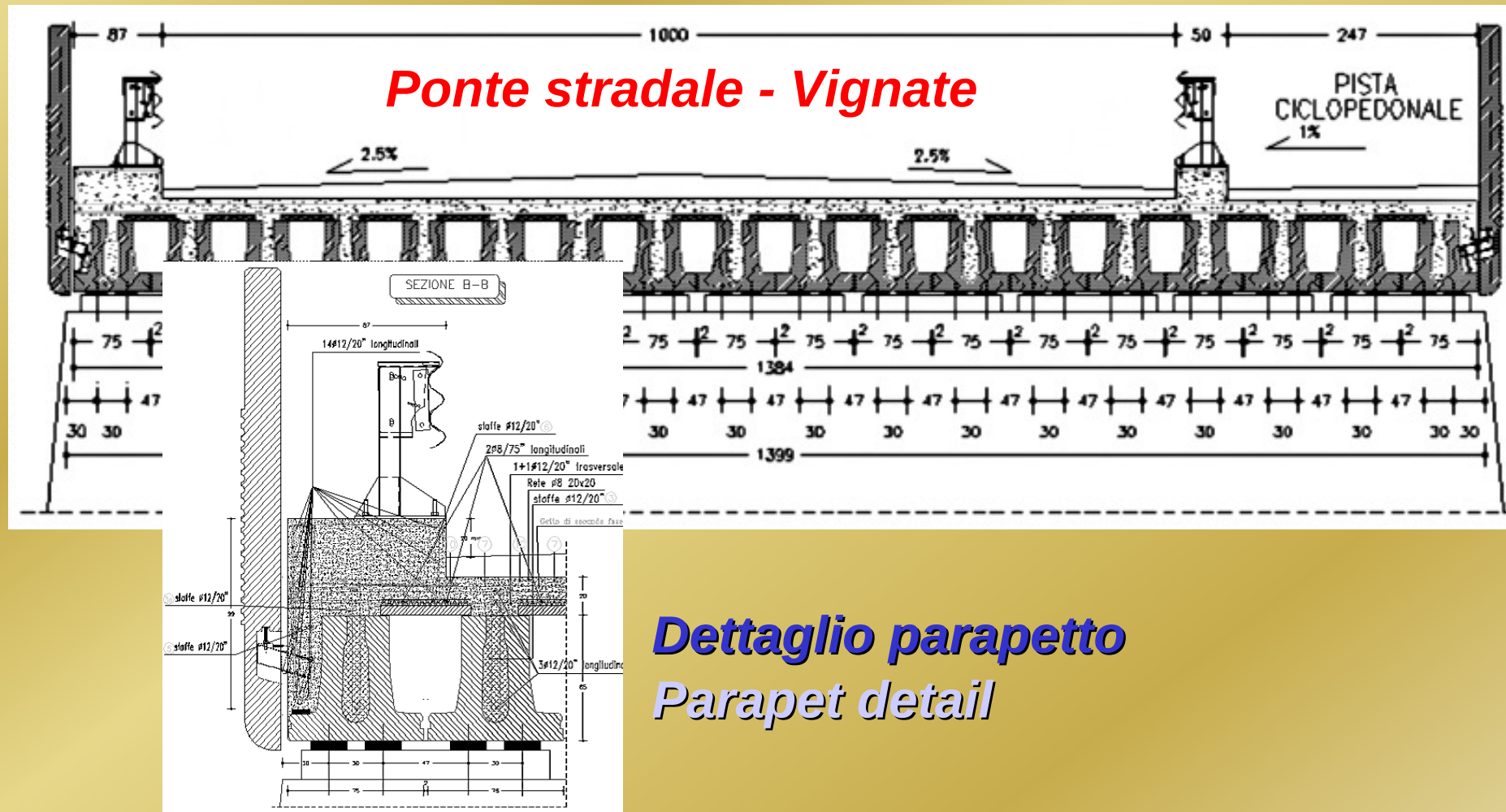
**Pianta ponte a 3 campate travi H 650 L 15.5/18/15.5 mt**  
*3-bay bridge with beams H 650 L 15.5/18/15.5 m*

# IMPALCATI STRADALI

Esempi applicativi e  
dettagli costruttivi

# DEEP BEAMS FOR BRIDGES

Construction examples  
and detailing



**Sezione trasversale impalcato con travi PAV**  
**Cross section of bridge with PAV beams**

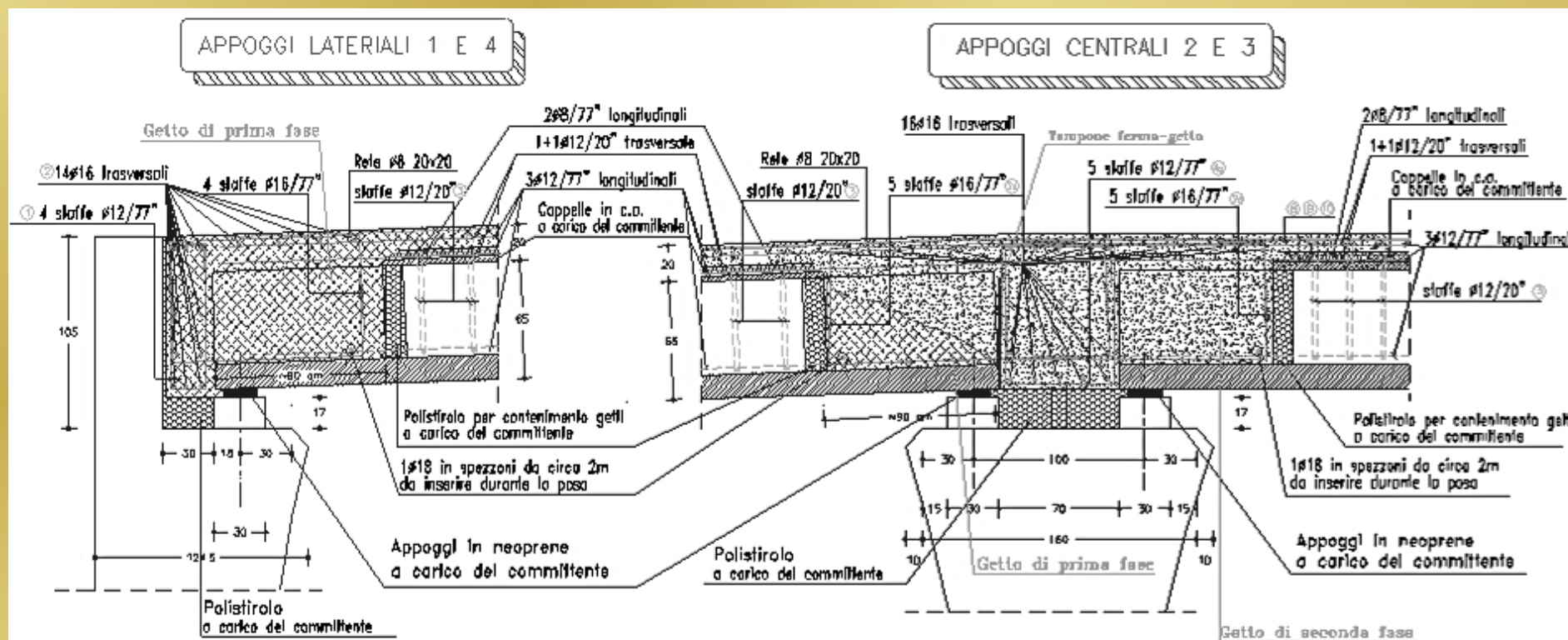
# IMPALCATI STRADALI

## Esempi applicativi e dettagli costruttivi

# DEEP BEAMS FOR BRIDGES

## Construction examples and detailing

### Ponte stradale - Vignate



## Dettaglio appoggi laterali e centrali

## External and intermediate continuous supports

## ***IMPALCATI STRADALI***

***Esempi applicativi e  
dettagli costruttivi***

## ***DEEP BEAMS FOR BRIDGES***

***Construction examples  
and detailing***



***Ponte stradale - Vignate***

***Vista del ponte con travi PAV vibrofinite***

***Views of bridge with slide-formed PAV beams***

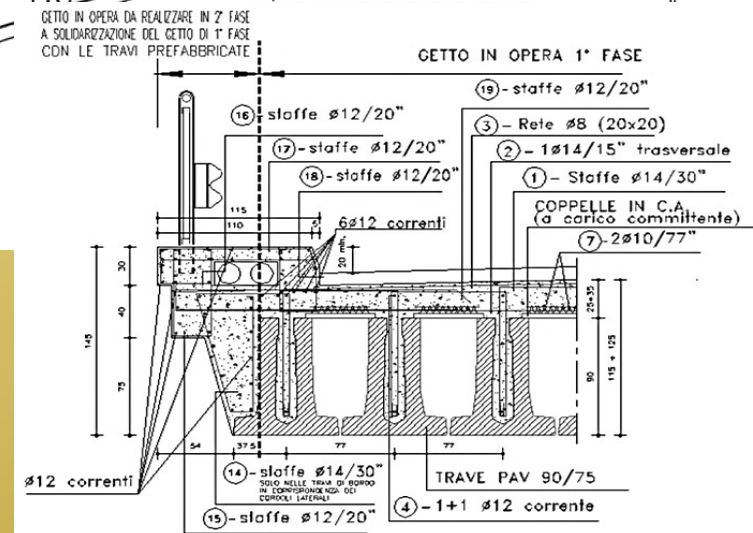


## Esempi applicativi e dettagli costruttivi

# Construction examples and detailing



### Beams distribution and guard-rail detail



## ***IMPALCATI STRADALI***

***Esempi applicativi e  
dettagli costruttivi***



***Ponte stradale - Como***

## ***DEEP BEAMS FOR BRIDGES***

***Construction examples  
and detailing***



***Vista travi durante la posa***  
***Precast beams during erection***

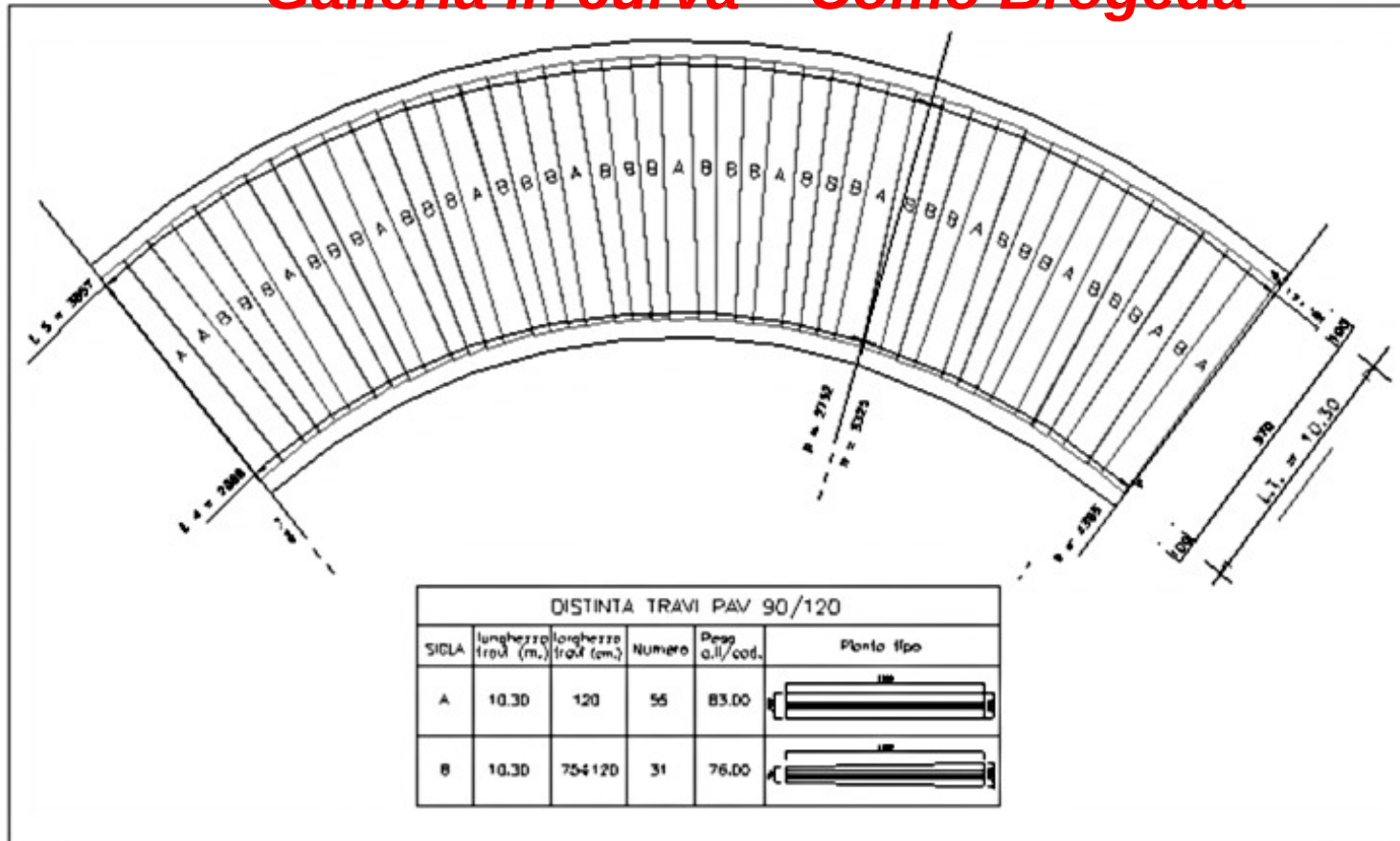
## IMPALCATI STRADALI

*Esempi applicativi e  
dettagli costruttivi*

## DEEP BEAMS FOR BRIDGES

*Construction examples  
and detailing*

### *Galleria in curva – Como Brogeda*



*Impalcato con travi a pianta trapezia*

*Beams distribution with trapezoidal elements*

## ***IMPALCATI STRADALI***

***Esempi applicativi e  
dettagli costruttivi***

## ***DEEP BEAMS FOR BRIDGES***

***Construction examples  
and detailing***

***Galleria in curva – Como Brogeda***



***Vista galleria artificiale  
Views of artificial tunnel***

## **IMPALCATI STRADALI**

***Esempi applicativi e  
dettagli costruttivi***



## **DEEP BEAMS FOR BRIDGES**

***Construction examples  
and detailing***



***Travi PAV con getto pieno e post compressione***  
***PAV beams fully casted + post-tension***



## ***IMPALCATI STRADALI***

***Esempi applicativi e  
dettagli costruttivi***



## ***DEEP BEAMS FOR BRIDGES***

***Construction examples  
and detailing***



***Particolare di post-tensione nel getto in opera***  
***Additional post-tension in cast in-situ webs***



# ***NORMATIVE AND DESIGN REFERENCES***

## ***Large span floor for civil/industrial/parking building***

- **Eurocode EN 1992.1.1 and EN 1992.1.2**
- **European Standard EN 1168 “Hollow Core” where applicable**

### **NOTES**

- **Shear reinforcement recommended**
- **Limit percentage of load distribution**
- **Reinforced topping 60-100 mm recommended**
- **Fire resistance analysis required**

# ***NORMATIVE AND DESIGN REFERENCES***

## ***Large span floor for bridges and road protection***

- **Eurocode EN 1992.2 (Bridges)**
- **European Std EN XXX (Precast bridge elements)**
- **Fib State of Art Report “Precast bridges”**
- **State or Regional Road/Railways Codes**

### **NOTES**

- **Shear reinforcement required**
- **Reinforced topping 150-200 mm required**
- **Mid transverse reinf. Required  $L > 15$  m**
- **Interface steel connectors not required**
- **Min thickness of webs and sup/inf flange**

**Thank you for attention**

