TC 4.4 ROAD BRIDGES AND RELATED STRUCTURES

AIPCR VIA PIARC

23rd WORLD ROAD CONGRESS

PARIS, 17-21 SEPTEMBER 2007

Palais des Congrès

ITALIAN TECHNICAL COMMITTEE

TC 4.4. Terms of Reference

2004 – 2007 four-year work cycle

Topic 1 : Design and construcion for durability

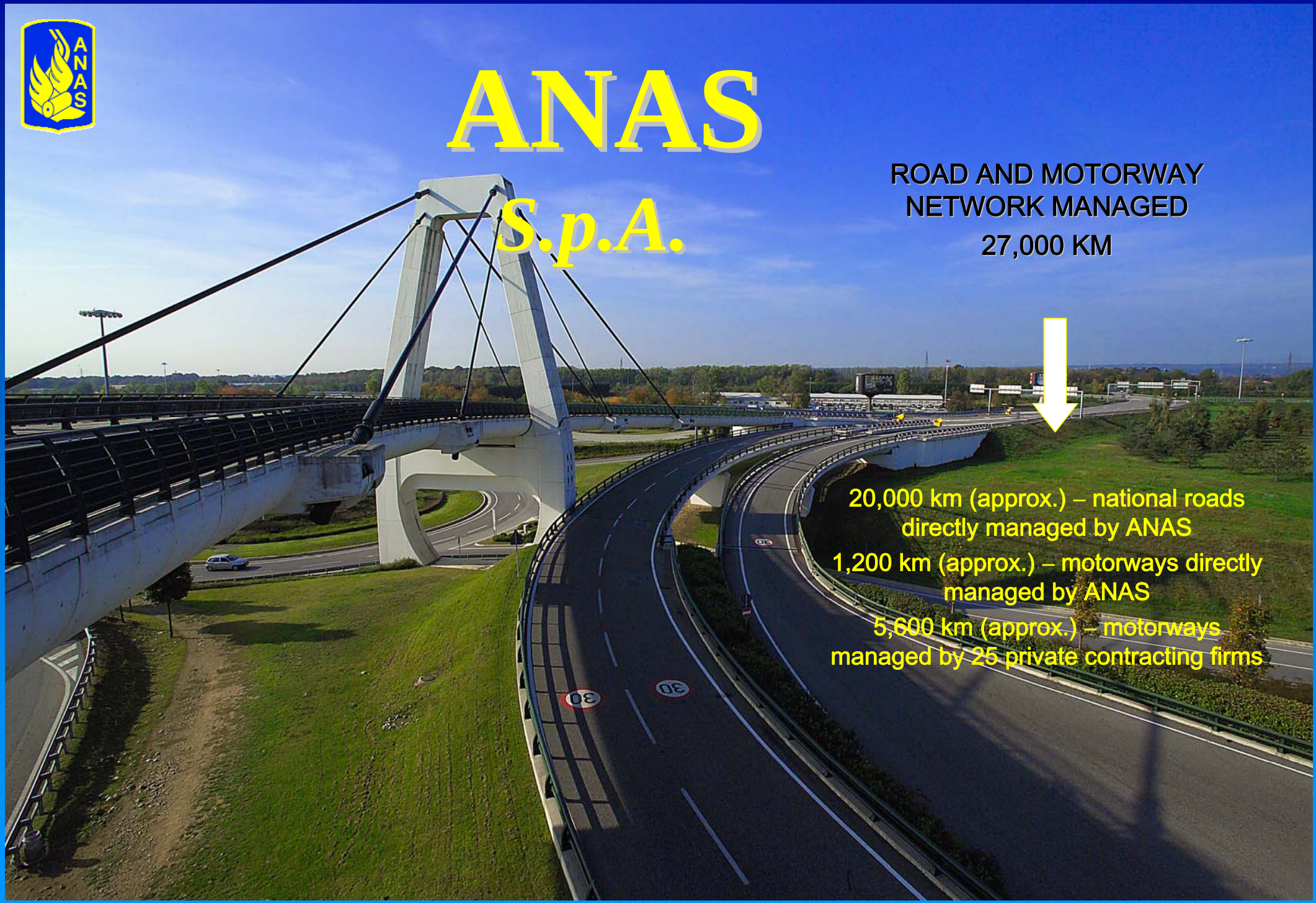
Chairman : Mr. Hayes, Brian

Topic 2 : Increase of durability and lifetime of existing bridges

Chairman : Mr. Bjerrum, John

Topic 3 : Approaches to cost effective management of bridges

Chairman : Mr. Graham, Peter


ANAS
S.p.A.
ROAD AND MOTORWAY NETWORK MANAGED
27,000 KM
20,000 km (approx.) – national roads directly managed by ANAS
1,200 km (approx.) – motorways directly managed by ANAS
5,600 km (approx.) – motorways managed by 25 private contracting firms

Mission

To manage Italy's road and motorway network of national importance, guarantee mobility, work constantly to adapt and maintain it in terms of efficiency, safety and passability, make provision for optimal integration with other transport systems and between different types of infrastructure giving special attention to design and environmental quality.

EXPERIMENTAL ROAD RESEARCH CENTER OF CESANO

- ***Built in 1962.***
- ***Classified (in 1968) as official National laboratory, with the specific duty "to set up research, laboratory analysis and studies in the road field"***
- ***Qualified (in 1971) as official National laboratory even in the field of concrete and metal structures (construction materials) after Legislative act n. 246 /1993 qualified as official laboratory for geotechnics analysis (soil and rock).***

– ***Research Areas***

– ***- Road database***

– ***- Pavement Laboratory***

– ***- Structures Laboratory***

– ***- Energy and Environment***

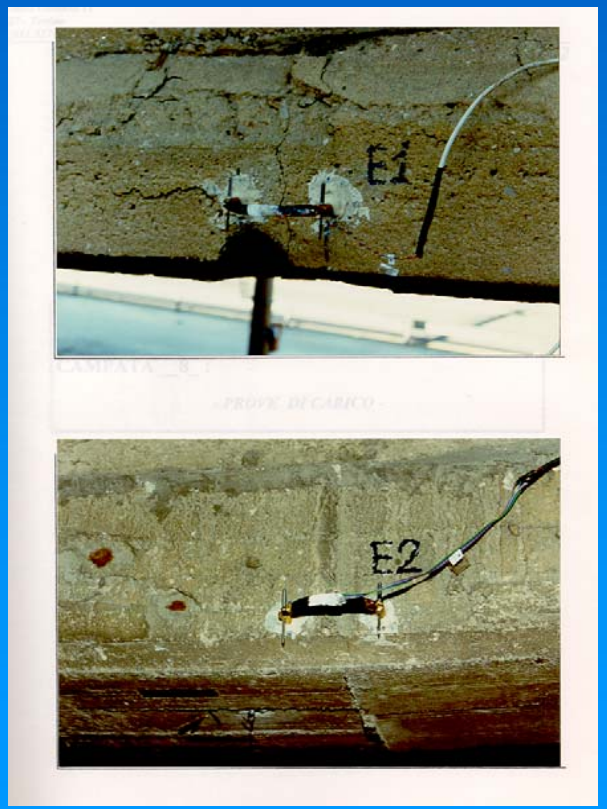
Anas S.p.A.

Pavement Laboratory

Structures laboratory

S.M.S. : Structural Management System on bridges

- **Periodic inspection**
- **Non Destructive Techniques**
- **Experimental static and dynamic tests**



Structures laboratory

Monitoring system

The objective of a monitoring system is to point out as soon as possible structural damages or changes in mechanical characteristics of structures. In order to obtain this goal and to put in practice a correct maintenance of structures we have to carry out periodical experimental tests. For a better explanation of the exprimental results we need:

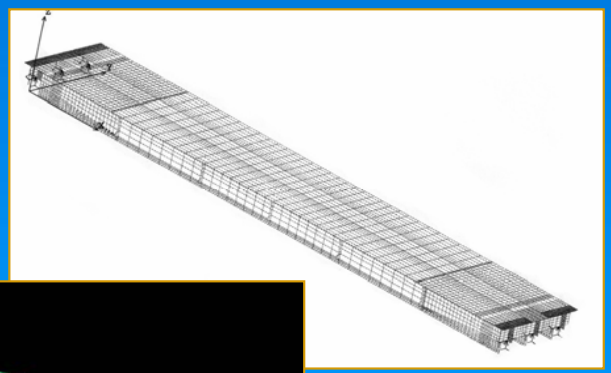
- **Numerical simulation techniques**

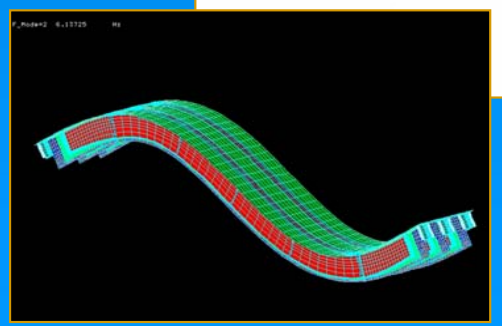
  (Finite Element Method)

- **Forecast models**

  (Autoregressive systems,

  Probabilistic Neural Network,…)





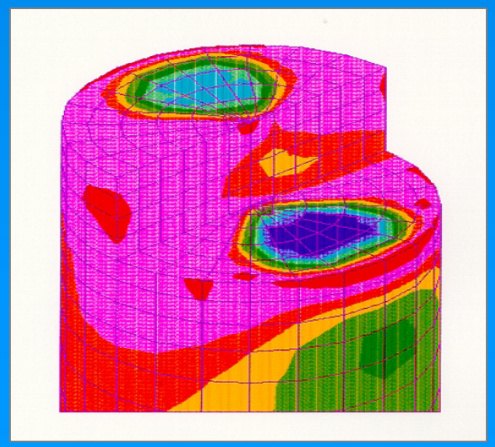
Structures laboratory

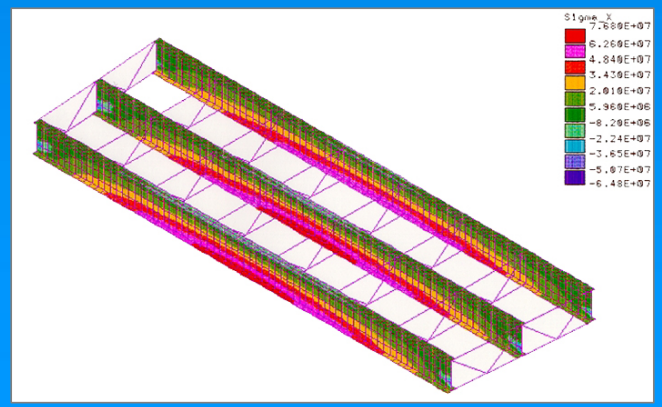
Finite Element Method: FEM

The simulation models are very suitable for the understanding of mechanical behaviour of structures but we need to estimate the mechanical and elastic characteristics of structures under investigation

Geometrical, mechanical and elastic parameters of structures

- Design
- Survey
  - NDT tests
  - Static and dynamic experimental test





Working group

EXTENDING THE SERVICE LIFE OF BRIDGES: GUIDELINES FOR THE DESIGN, CONSTRUCTION, AND MAINTENANCE STAGES

Analysis of the management aspects of existing road and highway bridges aimed at improving their performance characteristics and durability with a view to formulate technical recommendations for new bridges

Work Programme

- *Analysis of the reference standards*
- *General features of structures in service*
- *Causes of bridge deterioration*
- *Investigation methods and systems*
- *Assessment of extent of deterioration*
- *Methods of intervention on structures*
- *Bridge deck lifting methods*
- *Characteristics of materials used for repair measures*
- *Recommendations for new constructions*

General Lines of Analysis

Liberta' Bridge (Venice)

Construction stage

View from above
(Miozzi – Masonry arch bridge)

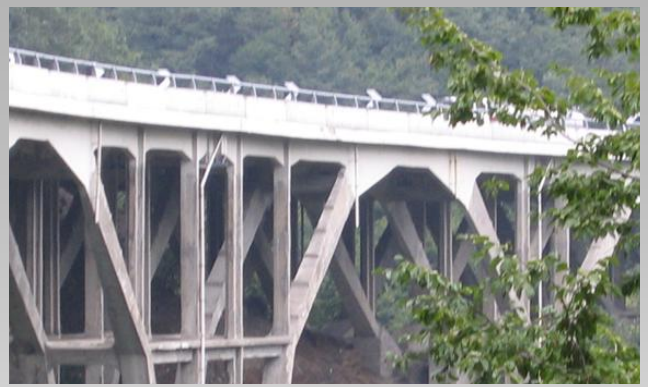
Bridge over Piave River at Cima Cogna (Belluno)

Side view

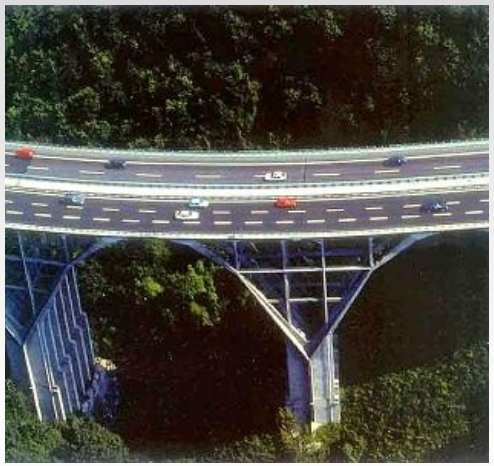
View from East abutment
(Miozzi – triple arch supported-deck bridge)

GENERAL FEATURES OF STRUCTURES IN SERVICE
SURVEY OF TYPICAL EXAMPLES

Poggettone e Pecora Vecchia Viaduct (Prato)



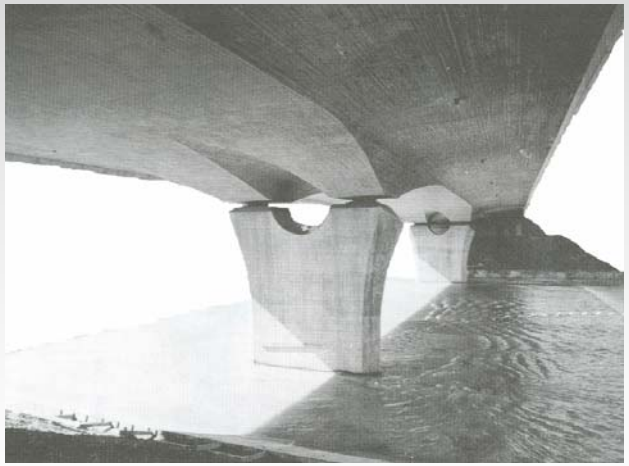
Side View



View from above
(Carè e Giannelli – Arch Bridge)

South Bridge on Parma Torrent (Parma)

Side View



View of piers and bridge deck
(Zorzi – continuous reinforced concrete box girder)

GENERAL FEATURES OF STRUCTURES IN SERVICE
SURVEY OF TYPICAL EXAMPLES

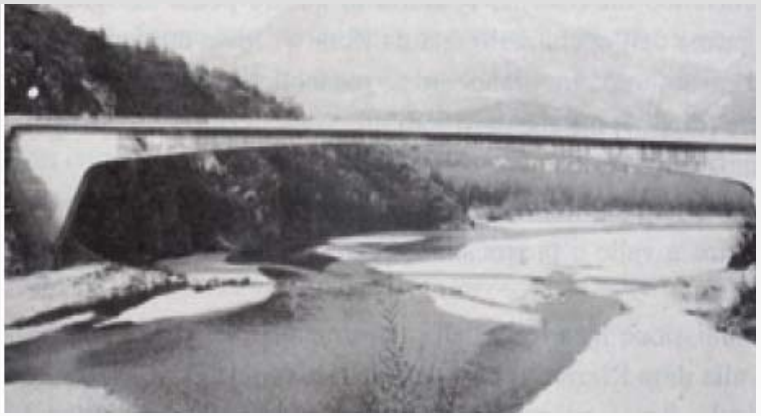
Cerrano Viaduct
(Pescara)

Right carriageway

View from below
(Tolaccia – box girder with monolithic piers)

Bridge over Tagliamento river at Pinzano
(Udine)

View from above



Side view
(Zorzi – hyperstatic reinforced concrete frame bridge)

GENERAL FEATURES OF STRUCTURES IN SERVICE
SURVEY OF TYPICAL EXAMPLES

Bridge over Piave at Caralte (Belluno)

Side view

Mounting of the inclined pier (Matildi – inclined pier steel frame)

Bridge over Gorzone Canal (Venice)

View of the deck underside

View from above (Russo e Prisco – hyperstatic reinforced concrete frame)

GENERAL FEATURES OF STRUCTURES IN SERVICE
SURVEY OF TYPICAL EXAMPLES

Fosso delle Macinaie Viaduct (Prato)

Panoramic view

Cross section
(Zorzi e Luzzati - Simply supported composite steel concrete Bridge)

Viaduct over river Irminio (Ragusa)

View of deck spans and piers

Overall view
(Morandi – steel box girder spans)

GENERAL FEATURES OF STRUCTURES IN SERVICE
SURVEY OF TYPICAL EXAMPLES

Deterioration by physical actions:
Washout and corrosion on halving joints

Deterioration by physical actions:
Washout and corrosion on crossheads

Deterioration by physical actions:
Freeze-thaw effects on the pier-bearing interface

Deterioration by accidental actions:
Fire

Deterioration by accidental actions:
Collision by over-dimension vehicles

Deterioration by hydrogeological actions:
Pier scouring

Deterioration by design and execution errors: Insufficient concrete cover triggering rebar corrosion

Deterioration by overloading and bearing defects. Cracking induced by increased loads

CAUSES AND EXTENT OF DETERIORATION

Deterioration:
Defects of expansion joints

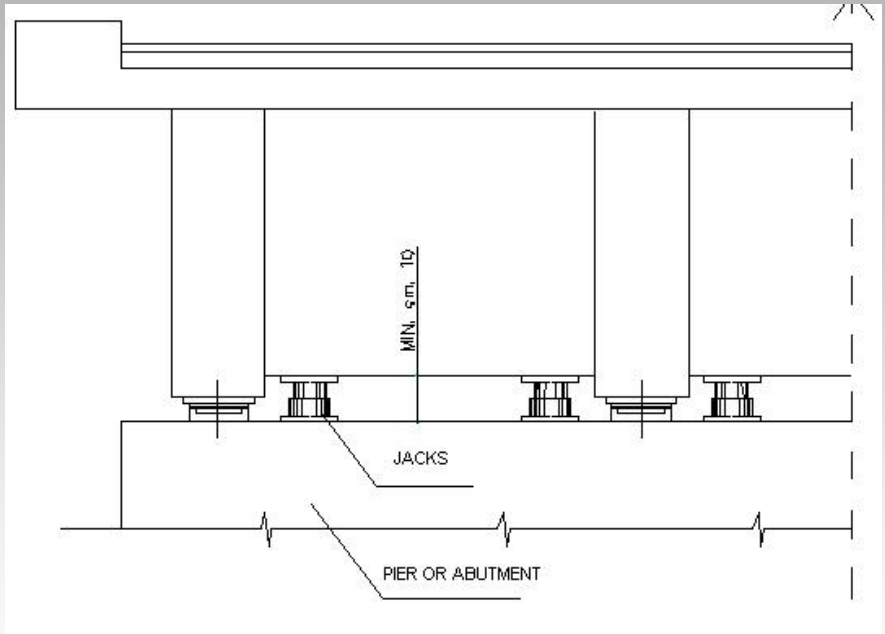
Deterioration by chemical actions:
Corrosion due to chloride attack

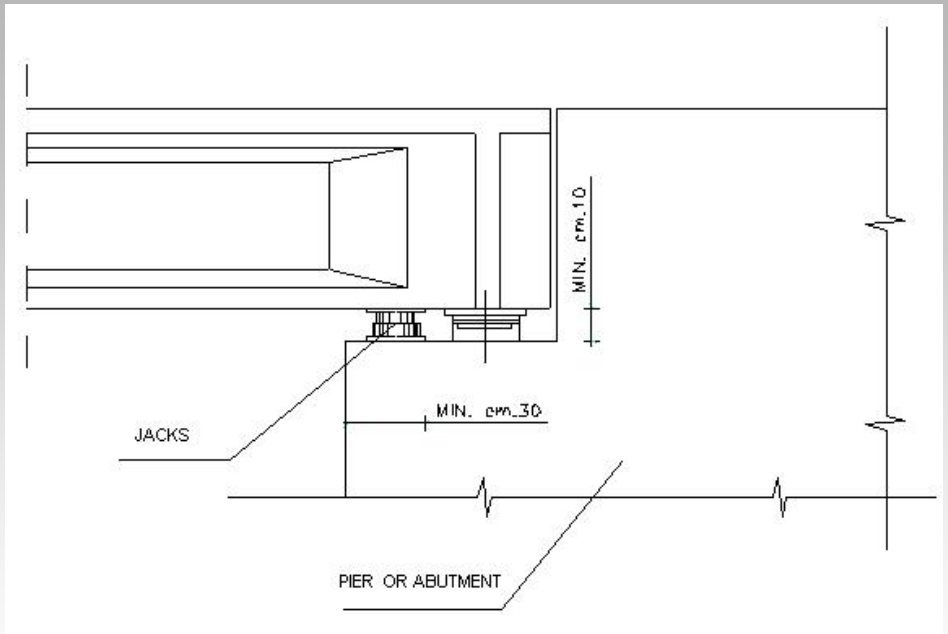
Methods of intervention on structures

- *Planned or Emergency - Repair measures*
- *Upgrading measures*
- *Improvement measures*
- *Consolidation measures*

Italian Ministerial Decree
D.M. 14/09/2005
Technical norms for construction
(Consolidated Act)
Italian Ministry of Infrastructure and Transport

BRIDGE DECK LIFTING METHODS



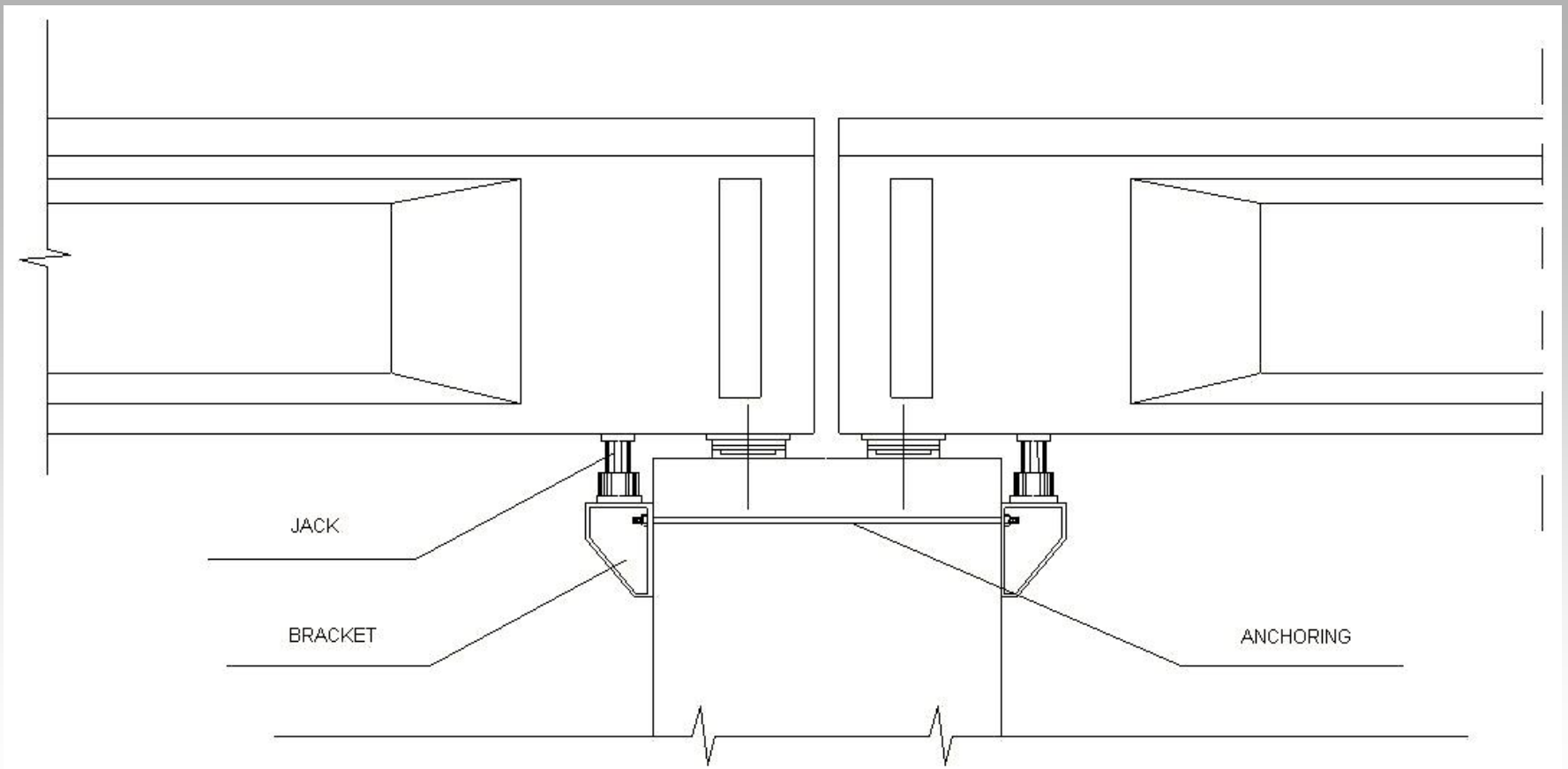


BY INSERTING JACKS BETWEEN CROSSBEAM AND PIER OR ABUTMENT

BRIDGE DECK LIFTING METHODS

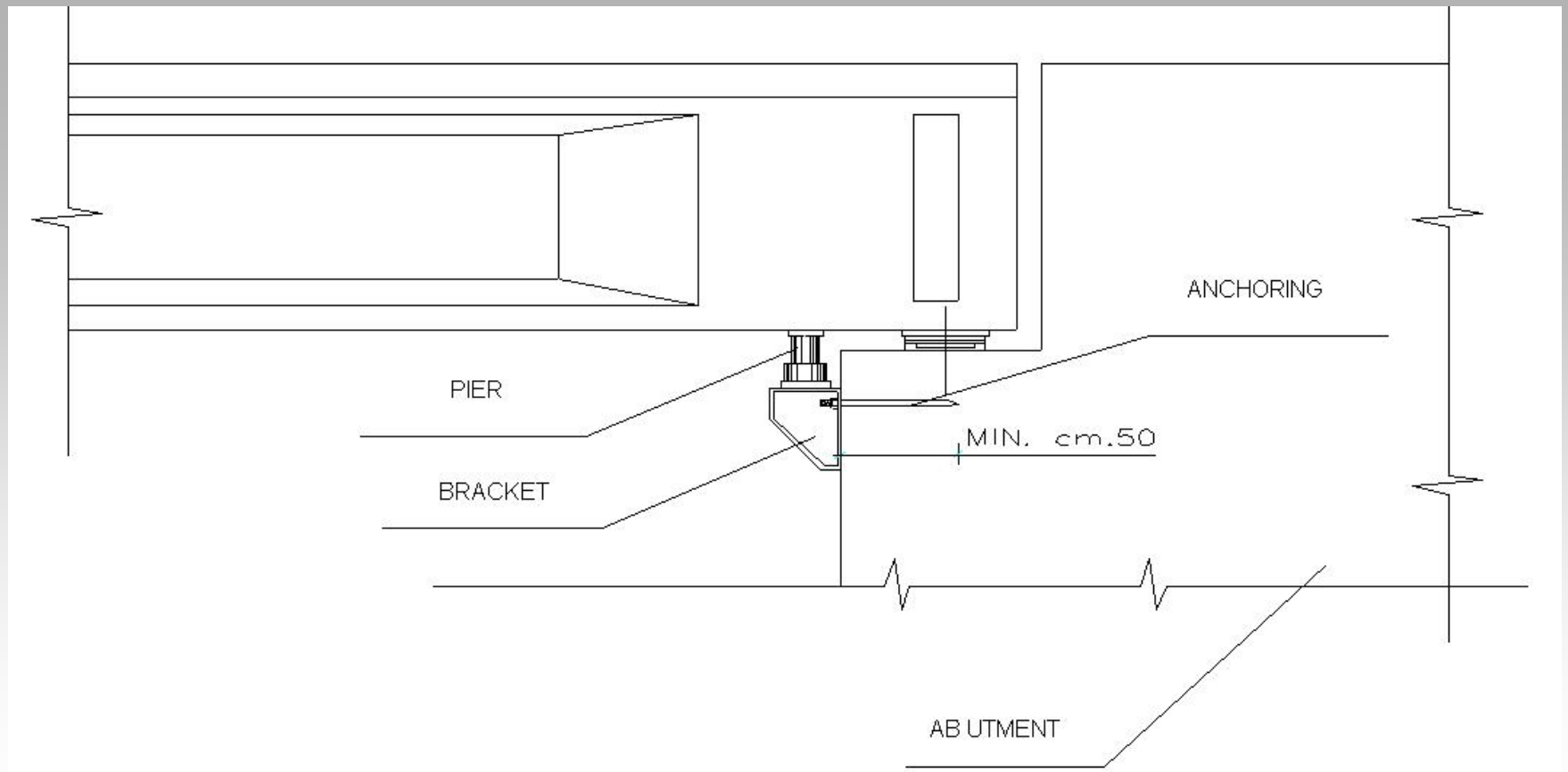
JACKS INSERTED BETWEEN CROSSBEAM AND PIER OR ABUTMENT

BRIDGE DECK LIFTING METHODS



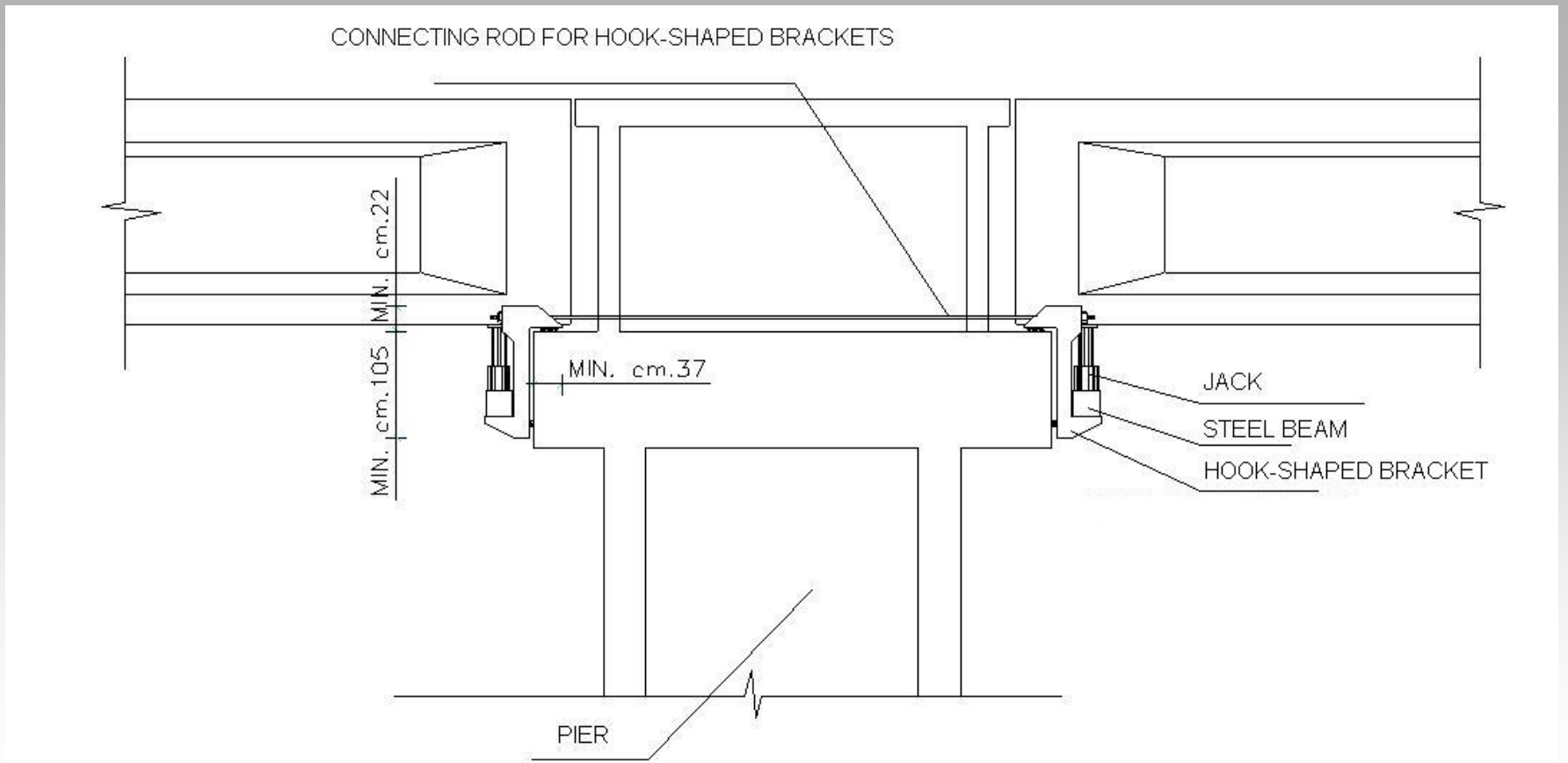
BY MEANS OF INTERCONNECTED BRACKETS ATTACHED TO PIERS

BRIDGE DECK LIFTING METHODS



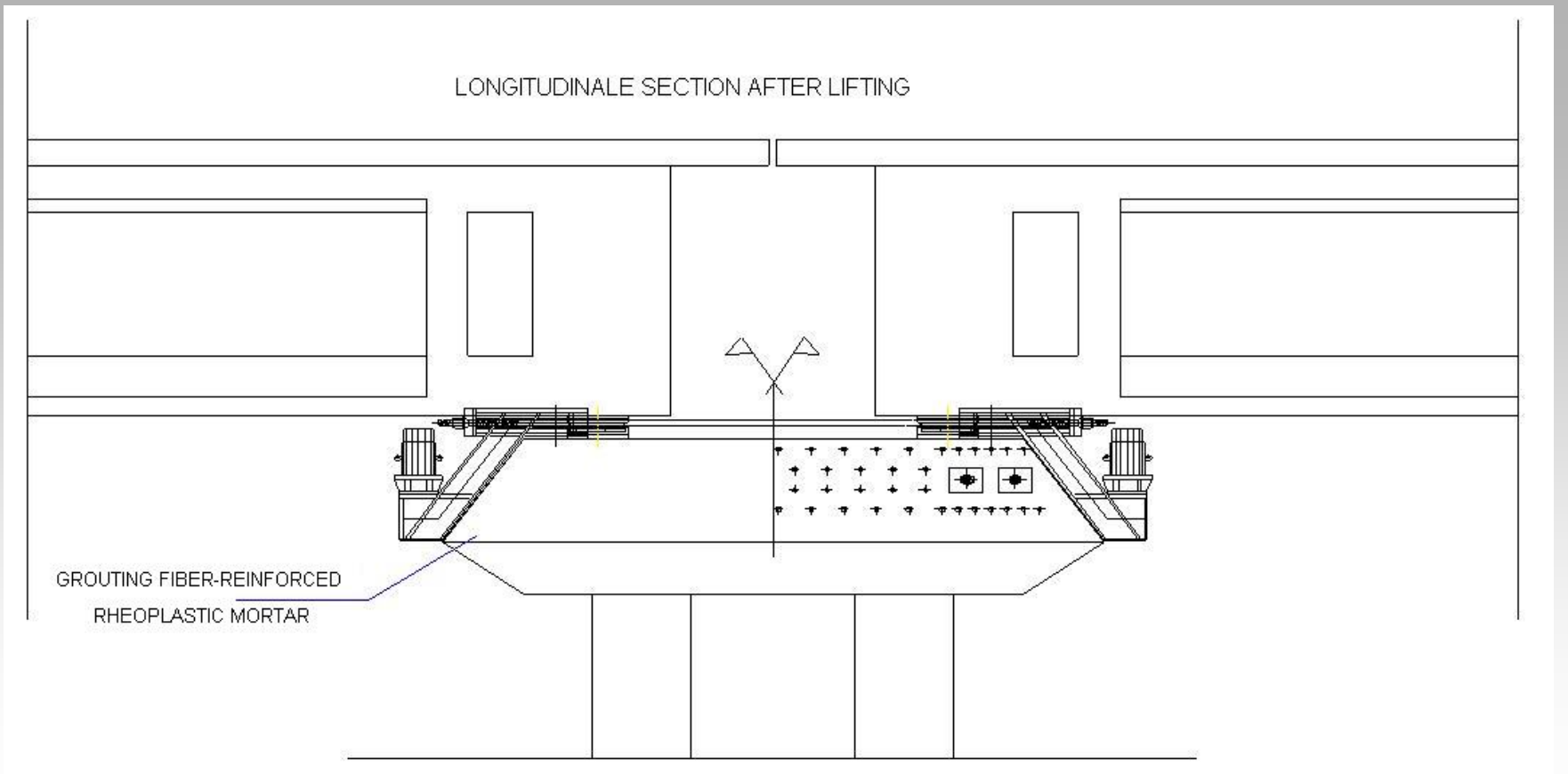
BY MEANS OF STEEL BRACKETS ATTACHED TO THE ABUTMENT

BRIDGE DECK LIFTING METHODS



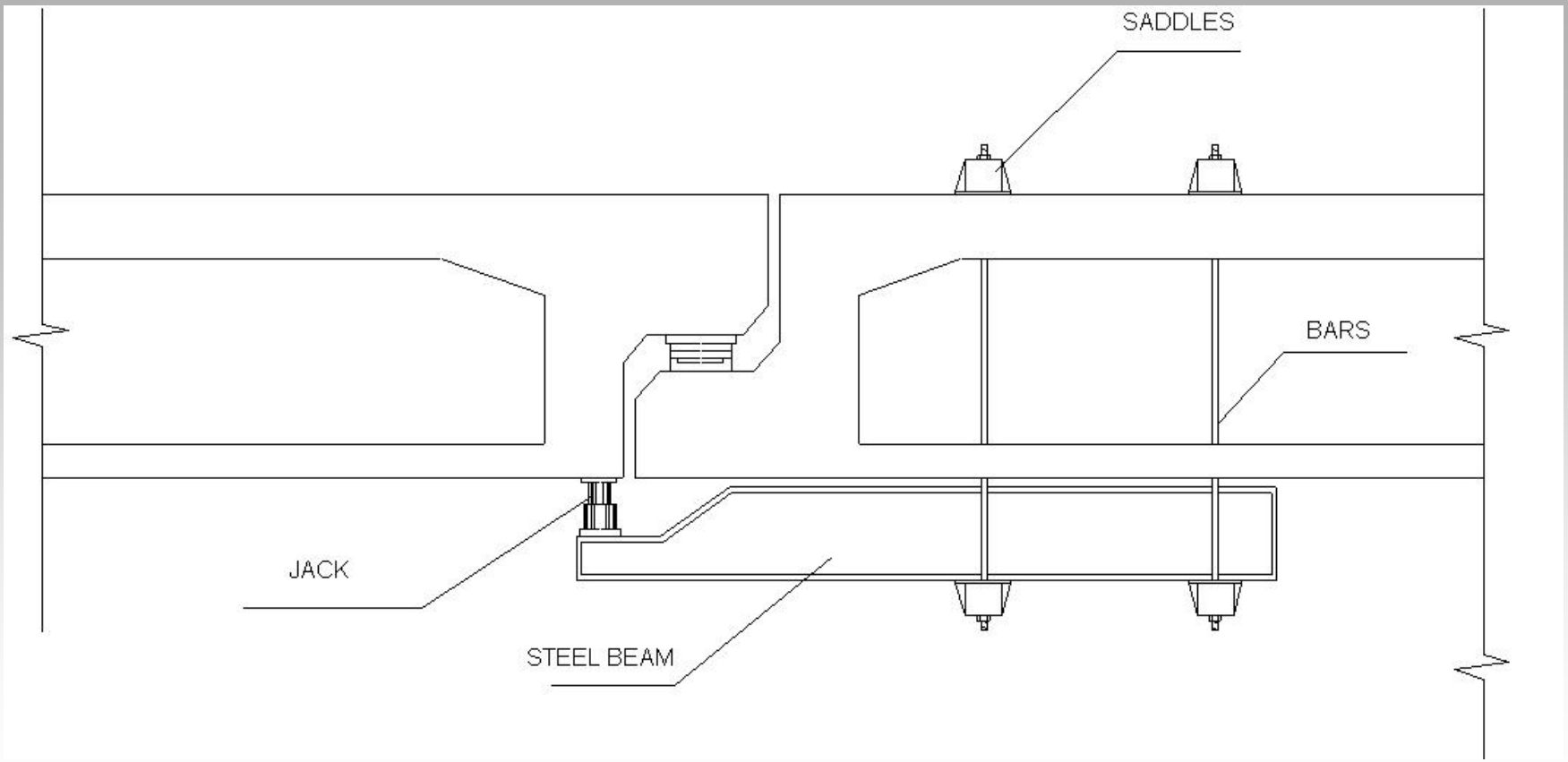
BY MEANS OF HOOK-SHAPED BRACKETS

BRIDGE DECK LIFTING METHODS



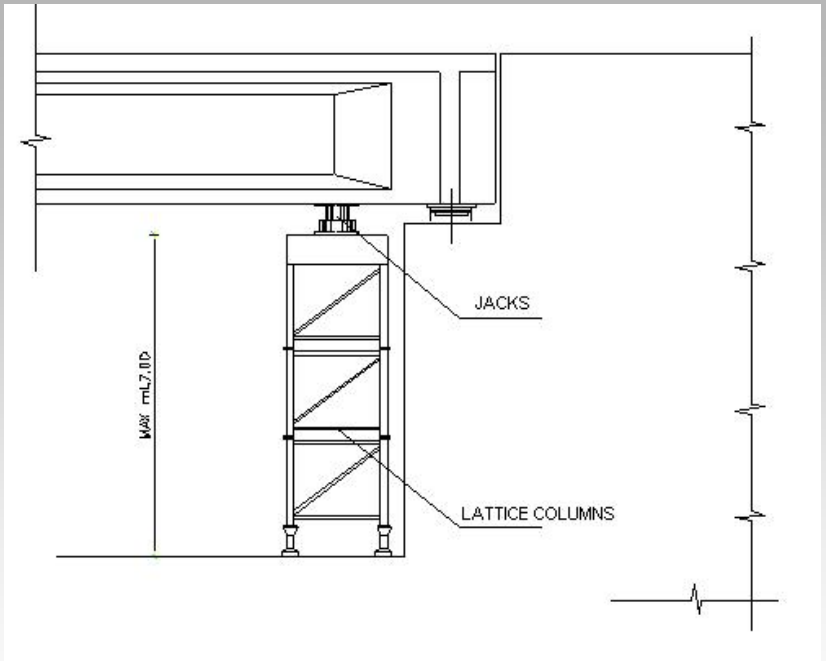
BY MEANS OF HOOK-SHAPED BRACKETS ADAPTED TO THE CROSSHEAD

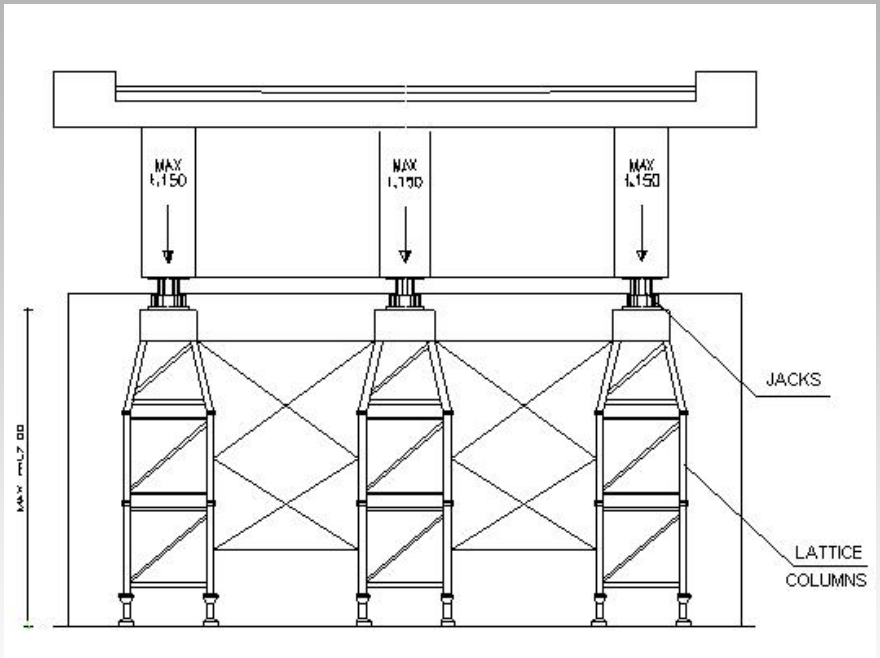
BRIDGE DECK LIFTING METHODS



"GERBER" HALVING JOINTS

BRIDGE DECK LIFTING METHODS



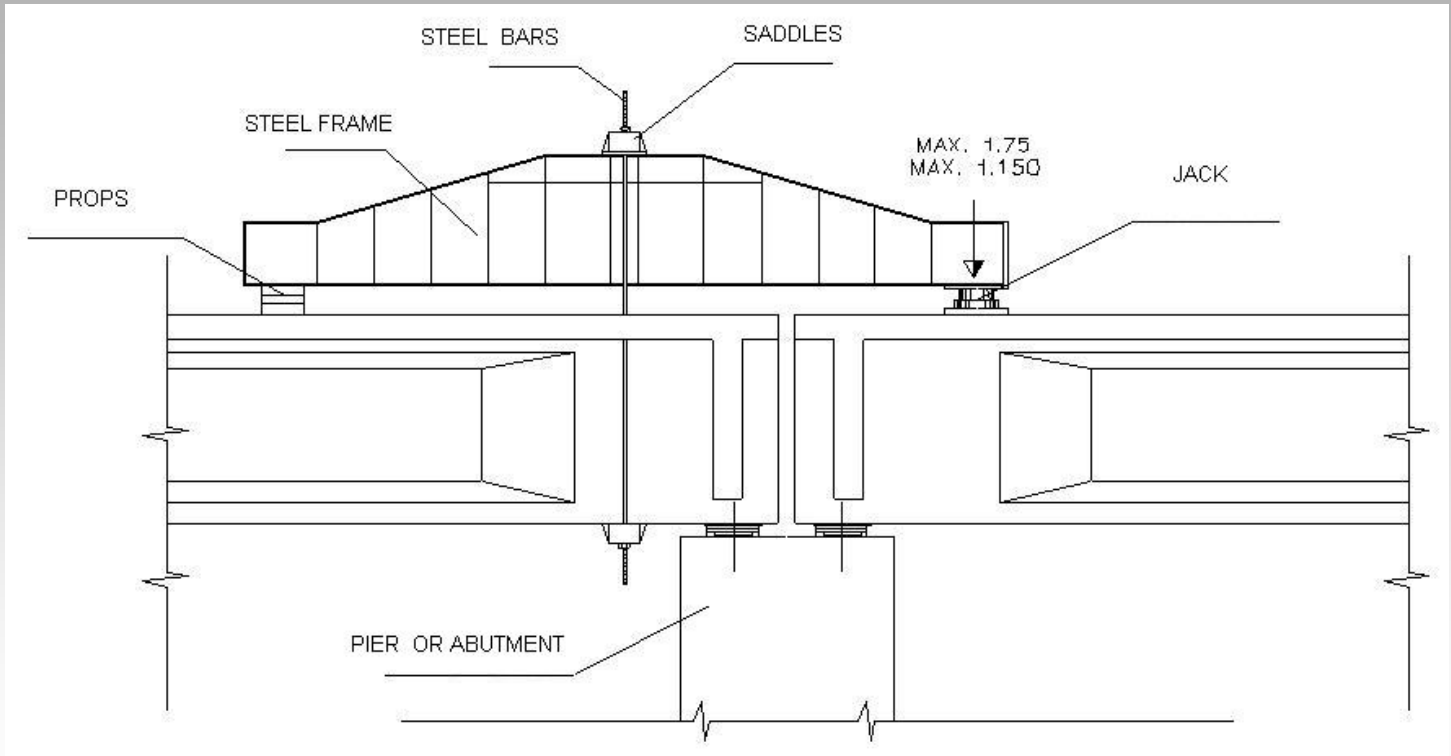


FROM UNDERNEATH BY USING LATTICE STEEL COLUMNS

BRIDGE DECK LIFTING METHODS

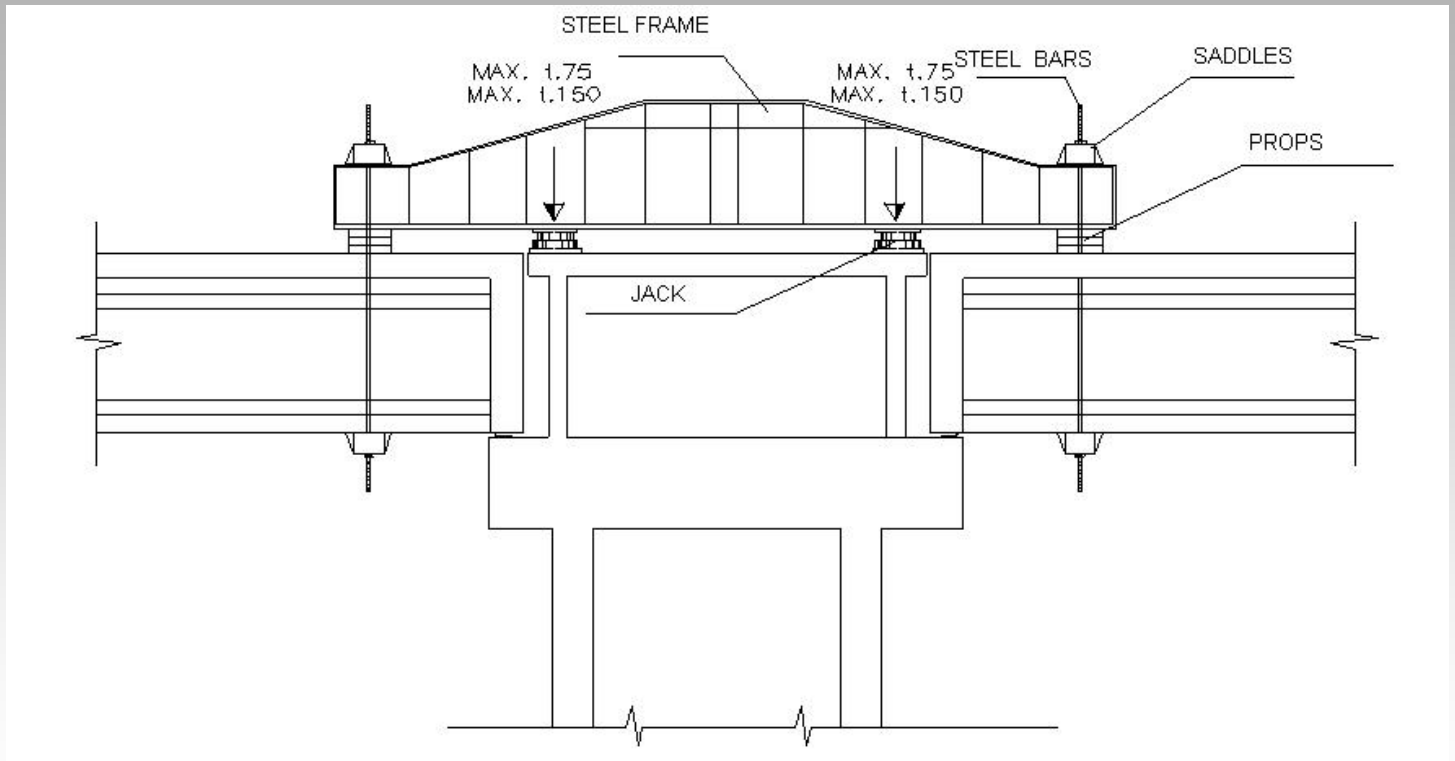
EXAMPLE OF PROPPING BY MEANS OF LATTICE STEEL COLUMNS

BRIDGE DECK LIFTING METHODS



FROM ABOVE USING STEEL BEAMS ACTING ON ONE GIRDER END

BRIDGE DECK LIFTING METHODS



FROM ABOVE USING STEEL BEAMS ACTING ON TWO GIRDER ENDS

BRIDGE DECK LIFTING METHODS

FROM ABOVE

ITALIAN TECHNICAL COMMITTEE

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- *Ing Francesco Mazziotta*
- *Ing. Fabrizio Russo*
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- *Geom. Mauro Cavetti*
- *Ing. Paolo Corrado*
- *Ing. Ruggero Gigli*

THANKS TO :

ANAS

Ministero delle Infrastrutture

autostrade per l'italia

spea autostrade ingegneria europea

TG S.p.A

FIP INDUSTRIALE

BASF The Chemical Company