Italian Roads in the 20th Century
FROM *RUPTA* TO HIGH-QUALITY ROAD AND MOBILITY MANAGER
A century-long process

Gabriele Camomilla

- ANAS Spa National Roads Network-Italy
- Terotechnologist -Road Construction and Management
- g.camomilla@stradeanas.it

THE ITALIAN AND EUROPEAN ROAD CULTURE

EUROPEAN ROADS "SPEAK" LATIN LANGUAGE

From the times of the ancient Rome....

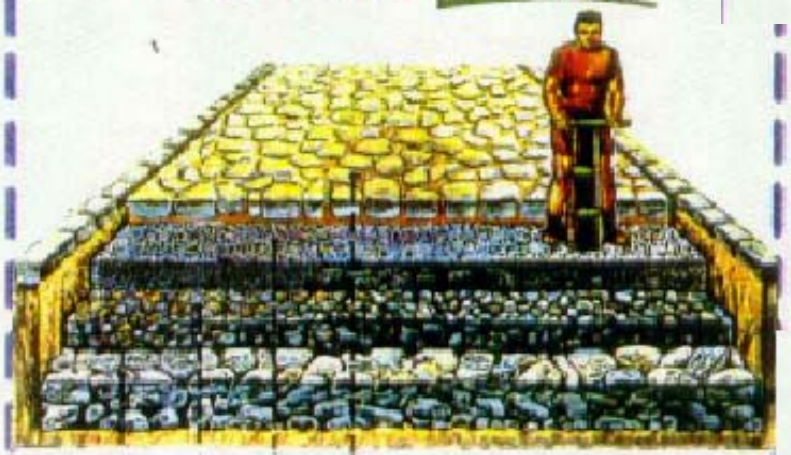
to the Middle Age

VIA

VEHA→VEHERE

The place where the goods pass

VIA SILICE STRATA



VIA RUPTA

for absence of maintenance

but also used

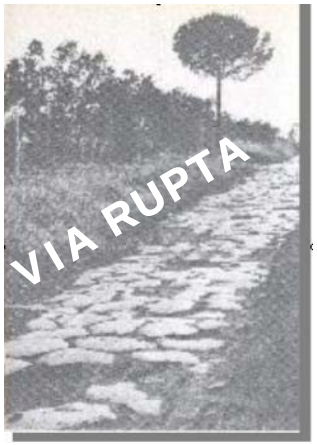
Pilgrims of Jubilea follow the "ROTTA"
Today in Italy is only a sailor's word

WEG
WAY

STRASSE
STRADA

ROUTE
ROAD
RUTA

100 YEARS AGO, IN ITALY



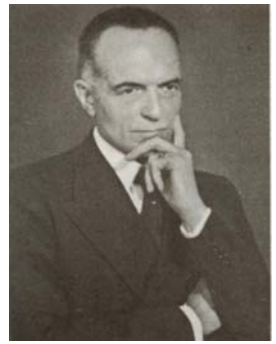
Roads were always "*ruptae*" (broken)

Many roads were "white"

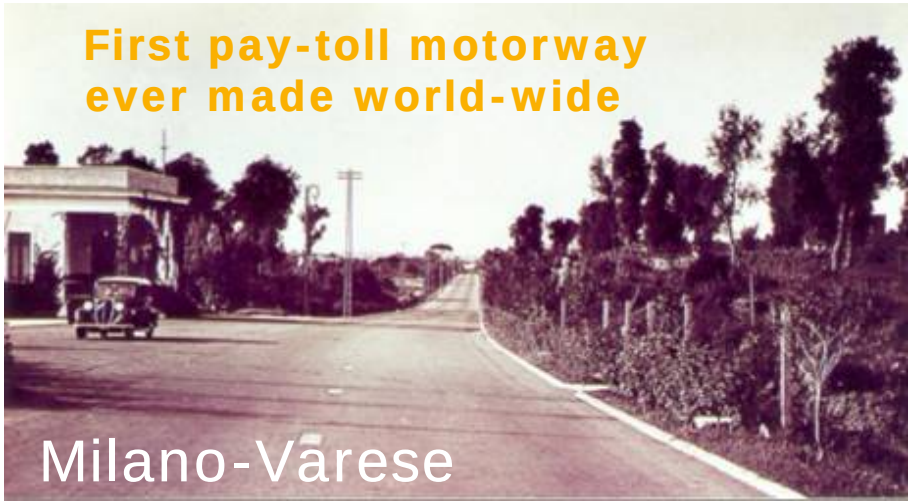
and many heavy vehicles had one HP engine

1924 MOTORWAY's BIRTH

ROAD WITH GOOD GEOMETRY, WITHOUT CROSSROADS, ONLY FOR ENGINED CARS



Engineer
Pietro Puricelli

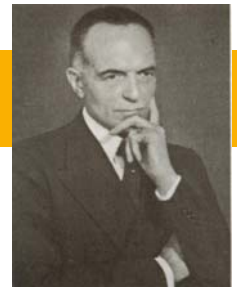


One Carriageway

Designed in 1922 open 1924 by
Società Anonima Autostrade
the first modern
Concessionary Company

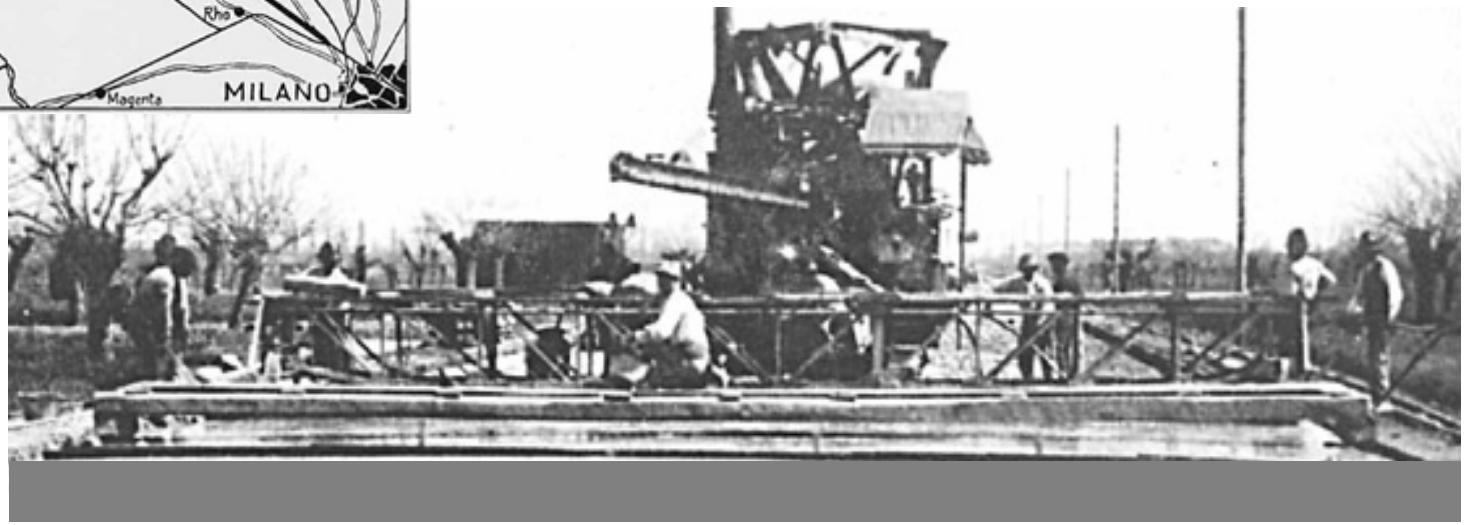
MOTORWAY WAS BORN IN ITALY

1st CONCRETE PAVEMENT



ROAD WITH GOOD GEOMETRY, WITHOUT CROSSROADS, ONLY FOR ENGINED CARS

All motorways had pavement made of reinforced concrete slabs with an average thickness of 20 cm.



Engineer Puricelli was involved also in the design of the German Motorway Network with concrete pavements, built before II World War

MODERNITY OF ANCIENT ITALIAN MOTORWAYS

ROAD WITH GOOD GEOMETRY, WITHOUT CROSSROADS, ONLY FOR ENGINED CARS

GENOVA
TRUCK MOTORWAY
(1935)

488 km before II^nd W.W.

1928 ITALIAN ROAD REORGANISATION

BIRTH OF A.A.S.S. (1° name of ANAS)

In the same period in Italy was born A.A.S.S.,
Independent organization for State Roads,
to develop national road network.

To be free from general bureaucracy !

- A.A.S.S. aimed at Constructing new roads
- A.A.S.S. aimed at the Equalization and Maintenance of the existing ones

With A.A.S.S. homogenization criteria, structures and methodologies were born to be applied to the most important Italian roads

1928 FIRST ITALIAN GLOBAL ROAD MANAGEMENT

With A.A.S.S.was born a
ROAD MANAGEMENT SYSTEM
with numerous activities of maintenance and operation.

.

Roads were broken down into stretches under the supervision of a head-roadman.

Thousand
"RED" HOUSES

"ALL IN HOUSE" SYSTEM

Roadmen operated locally for all problems, with special equipment, material warehousing and roadman houses.

1928 -1939 FIRST ITALIAN GLOBAL ROAD MANAGEMENT

All the ACTIVITIES were made "A POSTERIORI"
with the criteria "repair what is broken"
or "reintegrate the function interrupted"

Example: SNOW exploitation

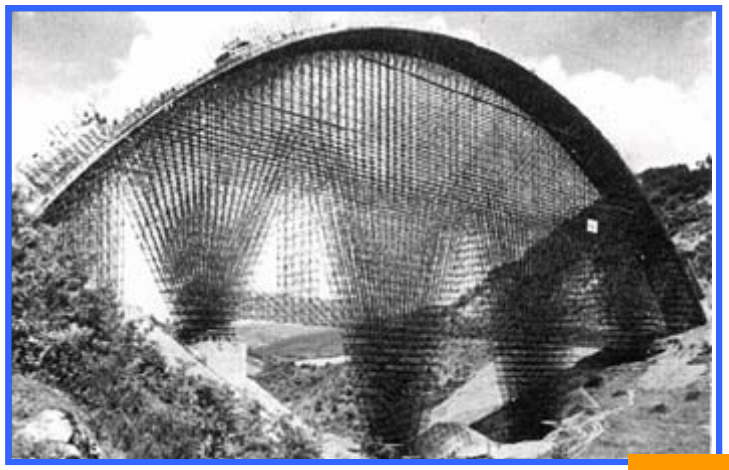
A.A.S.S. roadmen were re-tracing road on a mountain pass, before re-opening it with rotary-type snow plough (1932)

PREVENTIVE MAINTENANCE WILL BE BORN LATER, WITH HIGH TRAFFIC MOTORWAYS.

1956 First Italian Project-Financing : new motorways

IT IS THE MOST IMPORTANT EVENT AFTER THE DISTRUCTION AND RECONTRUCTION CAUSED BY II W.W.

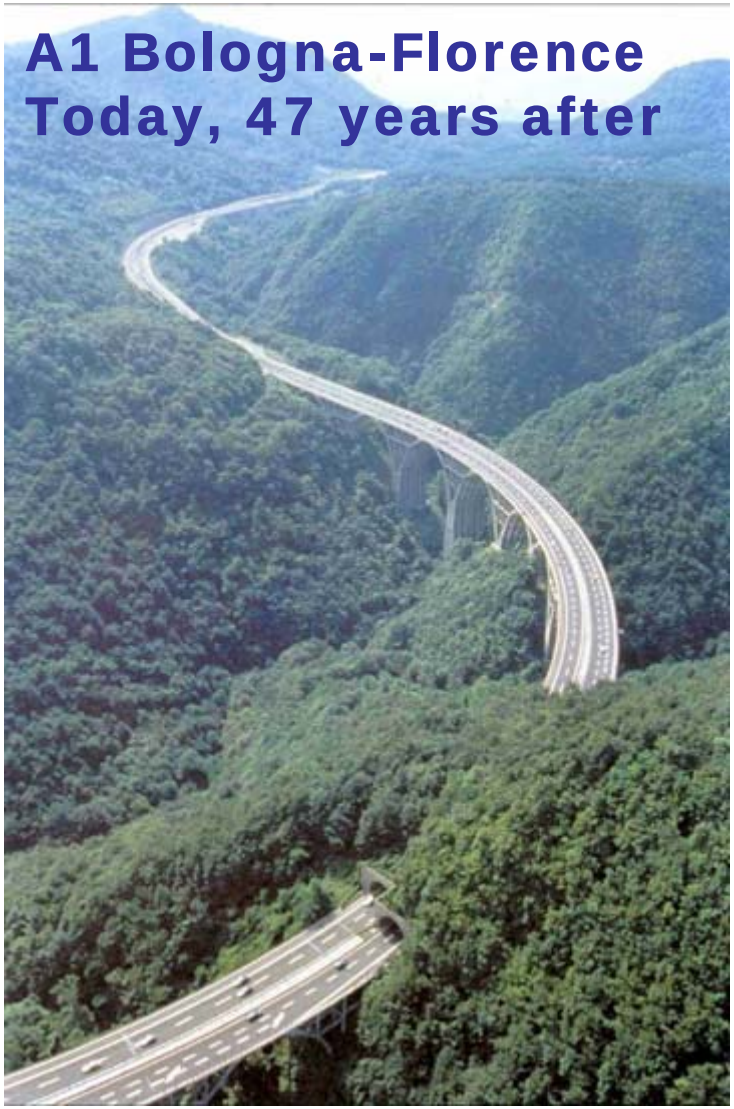
II generation of Italian motorways:
the "*Autostrada del Sole*"
Milan-Bologna-Florence-Rome-Naples (A1)
755 km BUILT IN 4 YEARS



Project manager *autostrade* Co.

24 m LARGE; 2 SEPARATED CARRIAGEWAYS; DISTANCE OF VISIBILITY ≥ 150m; FLEXIBLE PAVEMENTS IN BITUMINOUS MIXES

II GENERATION OF MOTORWAYS = TOLL MOTORWAYS



AFTER THE SUCCESS OF A1, THE DEVELOPEMENT OF THE NETWORK WAS SUBMITTED TO *"CONSTRUCTION AND MANAGEMENT CONCESSIONARIES"*

6000 Km WERE CONSTRUCTED IN 20 YEARS (integrated with OTHER 1000 CONSTRUCTED BY *ANAS* (THE OLD A.A.S.S.)

THE"CONCESSIONARIES" ALSO GAVE BIRTH TO THE MODERN MAINTENCE and EXPLOITATION of ROADS

1970 –Modern Road Maintenance and Management

With *autostrade Co.*(*the greatest of the concessionaries*) the modern exploitation was born (made not only directly but also with external firms).

TRANSFORMING THE "ALL IN HOUSE" SYSTEM, USED BY ANAS

Another very important transformation was:

ALL ACTIONS HAD TO BE PREVENTIVE OR IN REAL TIME

Example: SNOW Exploitation

ICE CONTROL AND SNOW REMOVAL ARE MADE WITHOUT STOPPING THE TRAFFIC (from 1965)

1980 –Programmed Maintenance (P.M.)

P.M. was first born for the PAVEMENTS

P.M. ANSWERS TO THESE QUESTIONS

- **WHERE** **WORK**
- **WHEN** **WORK**
- **HOW** **WORK**

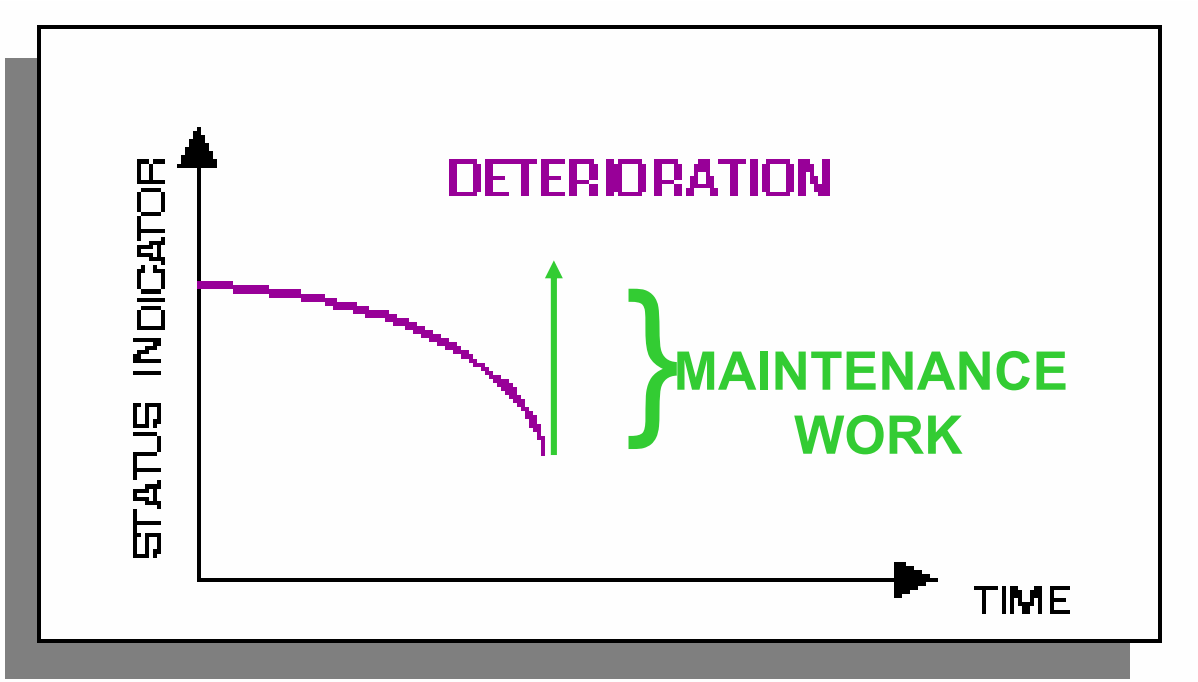
HOW MUCH **WORK COST**

USING SPECIFIC MEASURES

1980 –Programmed Maintenance (P.M.)

THE PRINCIPAL JOB WAS

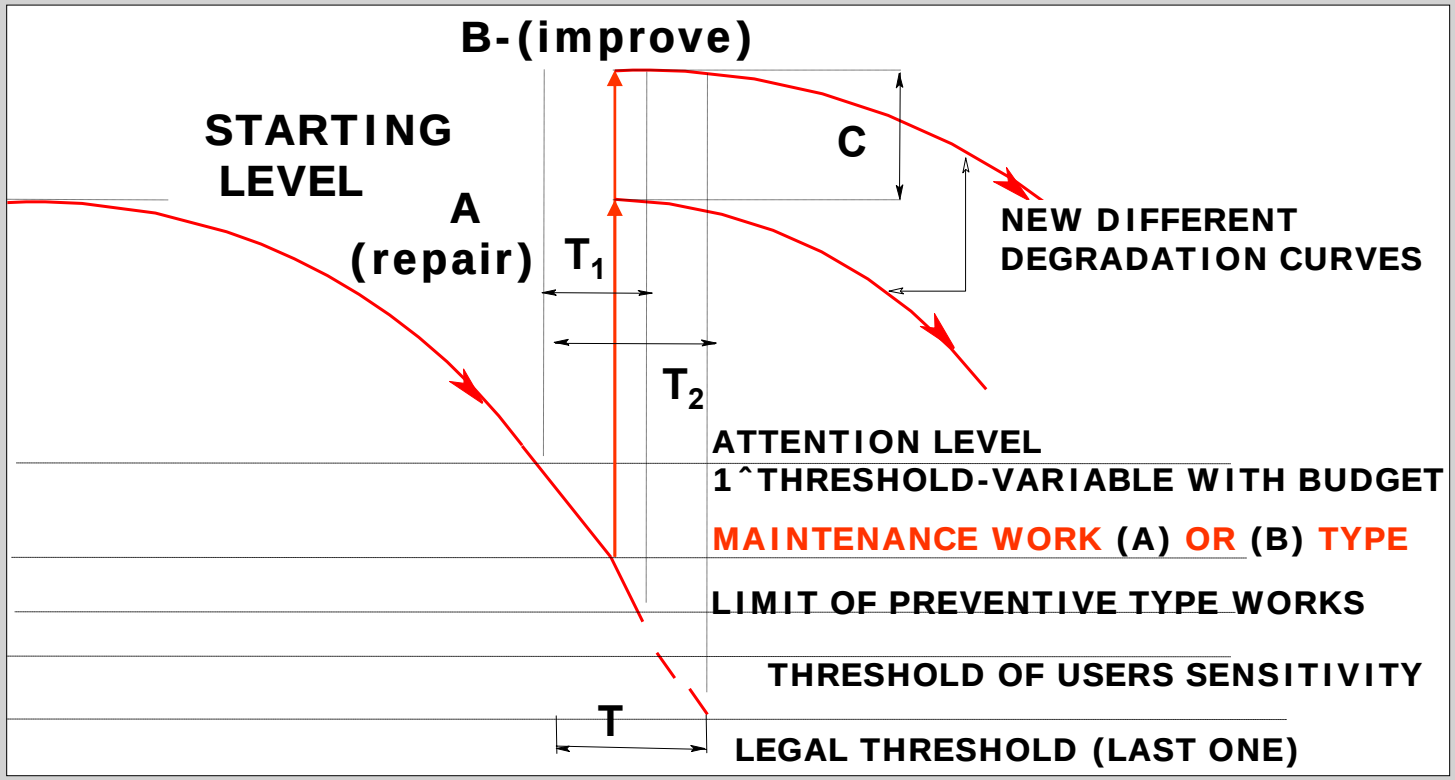
1st - STUDY AND MEASURE THE DEGRADATION with TECHNICAL PARAMETERS



2nd - DESIGN AND IMPLEMENT REPAIR WORK

From 1983

Degradation measured by Performance Indicators

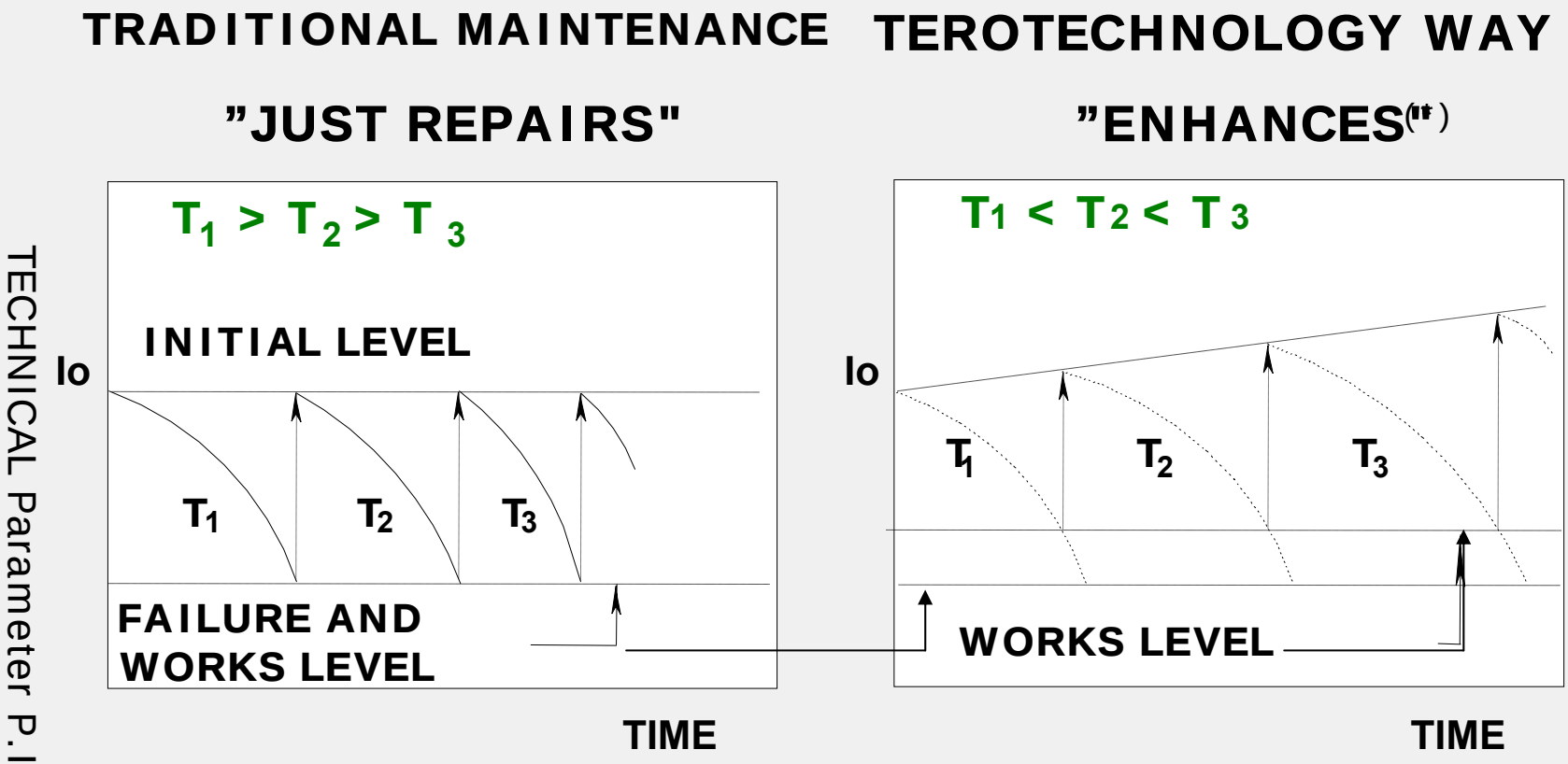


T= DECISIONS MAKING TIME < PREVENTION T_1 / REPARATION T_2

C= QUOTE OF FUNCTIONAL IMPROVEMENT (B - A)

The use of Performance Indicators allows the **PREVISION** of RUPTURES and thus the exploitation of P.M. called:

ROAD TEROTECHNOLOGY



(*) QUALITY INCREASES IN THE TIME

1980-1990 – Programmed Maintenance (P.M.)

1st - MEASURE THE DEGRADATION

TO IMPLEMENT PAVEMENT P.M. A SERIES OF SUB-INDICATORS (Technical Parameters) WERE DEFINITED :

- ADHERENCE
- TEXTURE
- EVENESS
- BEARING CAPACITY
- ROLLING NOISE

MEASURABLE WITH HIGH PERFORMANCE MACHINES

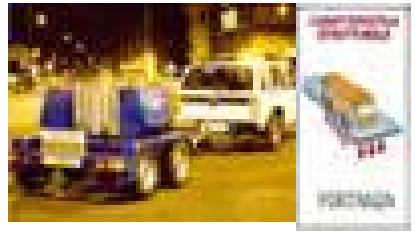
IN THIS WAY IT WAS DEFINED THE PERFORMANCE INDICATOR OF PAVEMENT:

I_{PAV}

1980 - 1990 – Programmed Maintenance (P.M.)

1st - MEASURE THE DEGRADATION

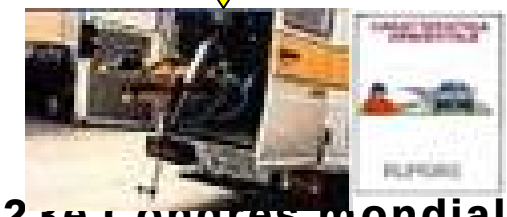
EXAMPLE OF DIFFUSED
Hig Performance Machinery



I PAV

ORIZZONTAL SIGN

THICKNESS



P.I. OF PAVEMENTS STATUS

1975 - 1985 – Programmed Maintenance (P.M.)

2nd - DESIGN AND IMPLEMENT REPAIR WORK

ADVANCED STUDIES ON PAVEMENTS ***Started in 1977***

(USING RESULTS FROM EXPLOITATION OF ROADS VERIFIED WITH *FULL SCALE* EXPERIMENTS)

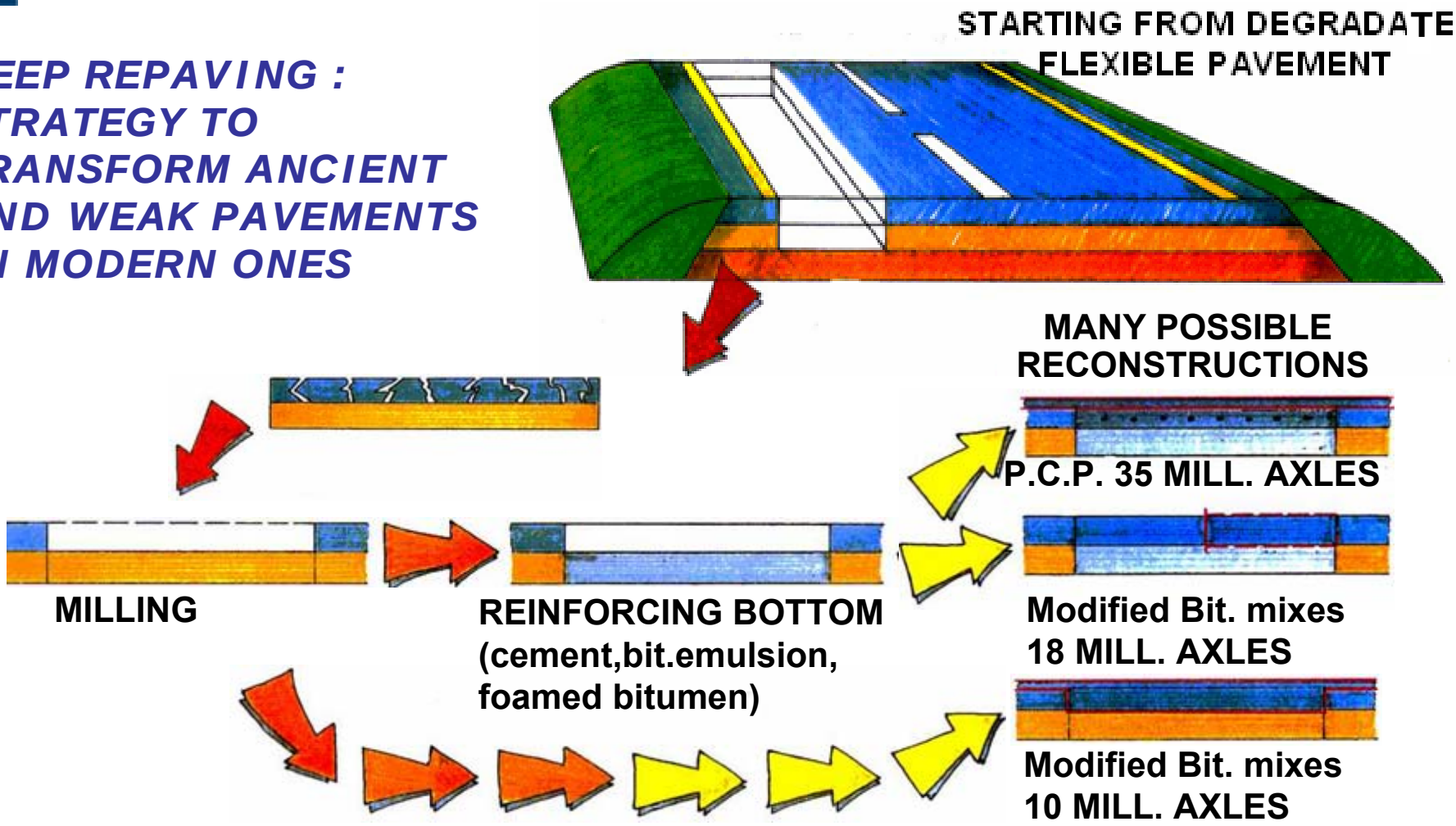
1977 – 1985
EUROPEAN FULL SCALE TEST OF NARDÒ

From the results of this experiment, the measure of different aggressiveness or heavy vehicle.

1980 - 1998 – Programmed Maintenance (P.M.)

2nd - DESIGN AND IMPLEMENT REPAIR WORK

DEEP REPAVING : STRATEGY TO TRANSFORM ANCIENT AND WEAK PAVEMENTS IN MODERN ONES

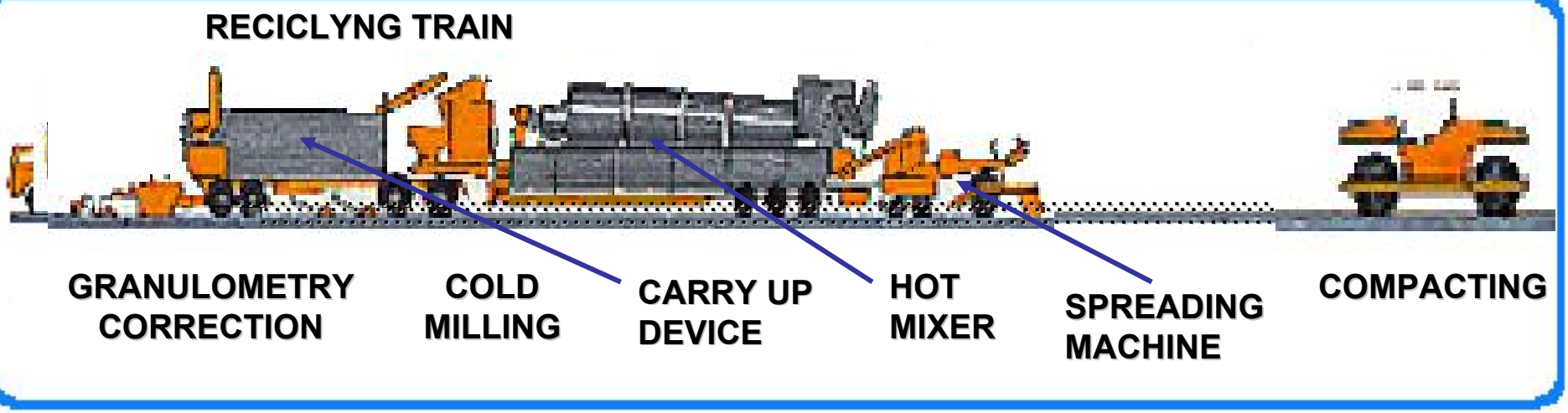


MAINTENANCE IMPROVES EXISTING PAVEMENTS

2nd - DESIGN AND IMPLEMENT REPAIR WORK

INNOVATIVE TECHNOLOGIES - *IN SITU* HOT RECYCLING

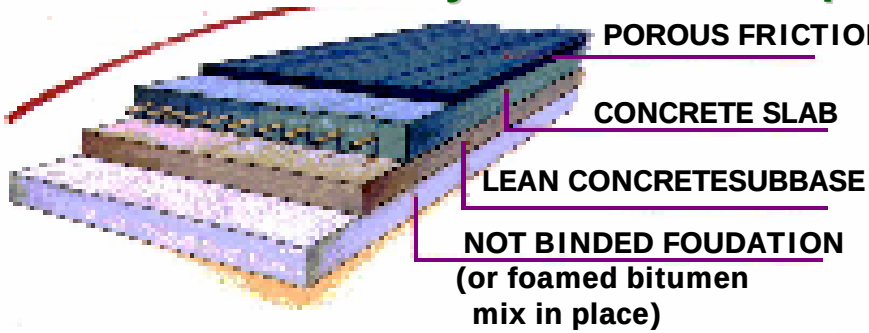
Started in 1985



INNOVATIVE TECHNOLOGIES – P.C.P. INSERTION

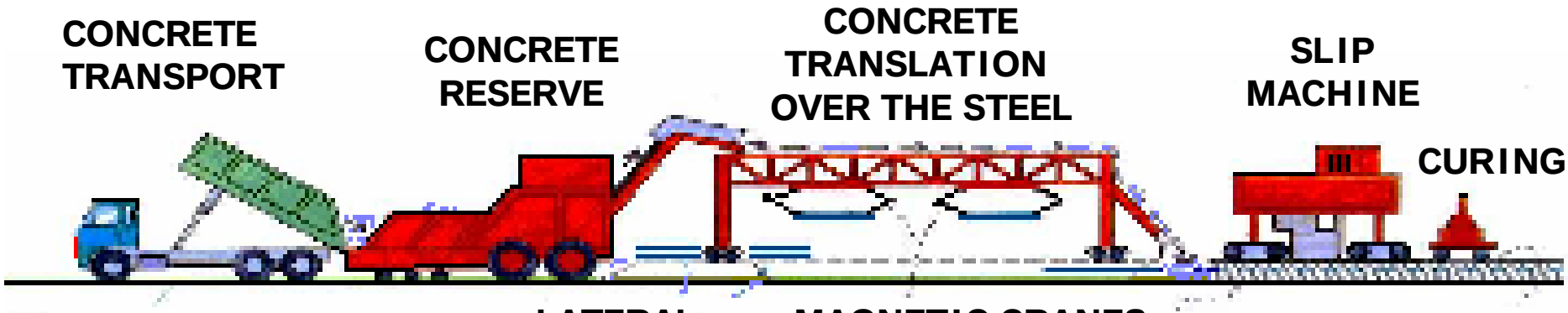
Started in 1990

"P.C.P." Polyfunctional Composite Pavement



CONTINUOUS REINFORCING CONCRETE SLABS inserted in cracked old pavement

LAYING TRAIN



INNOVATIVE TECHNOLOGIES – *IN SITU* COLD RECYCLING

On site COLD recycling approach

Started in 1999

- **with modified bitumen emulsion and cement**
- **with foamed bitumen and cement**

THE BLACK & WHITE TECHNIQUE

One century of Italian Pavement Evolution

1907

White Pavement (Macadam)

1925

Reinforced Concrete slab

1957

Granular mix

Flexible pavement With bituminous mixes

1965

Italian semirigid Pavement

Bituminous part is proportional to lean concrete part

1985

PCP Polifunctional Concrete Pavement

1999

Concrete Euphonic slab

PAVEMENTS FRIENDS OF THE ENVIRONMENT

One century of Italian Pavement evolu

SILENT ROAD for URBAN and EXTRAURBAN USE

1985

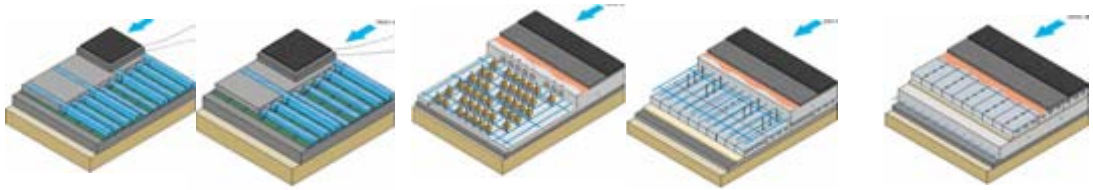
1999
ITALIAN
EUPHONIC PAVEMENT

FROM

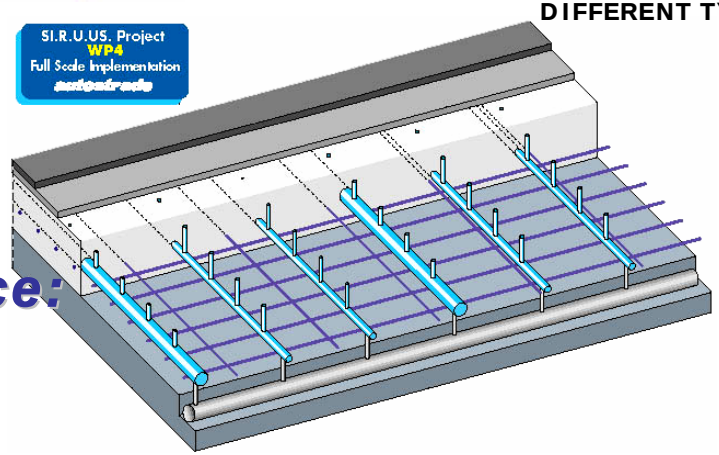
PCP Polifunctional Concrete Pavement

TO

Concrete Euphonic slab



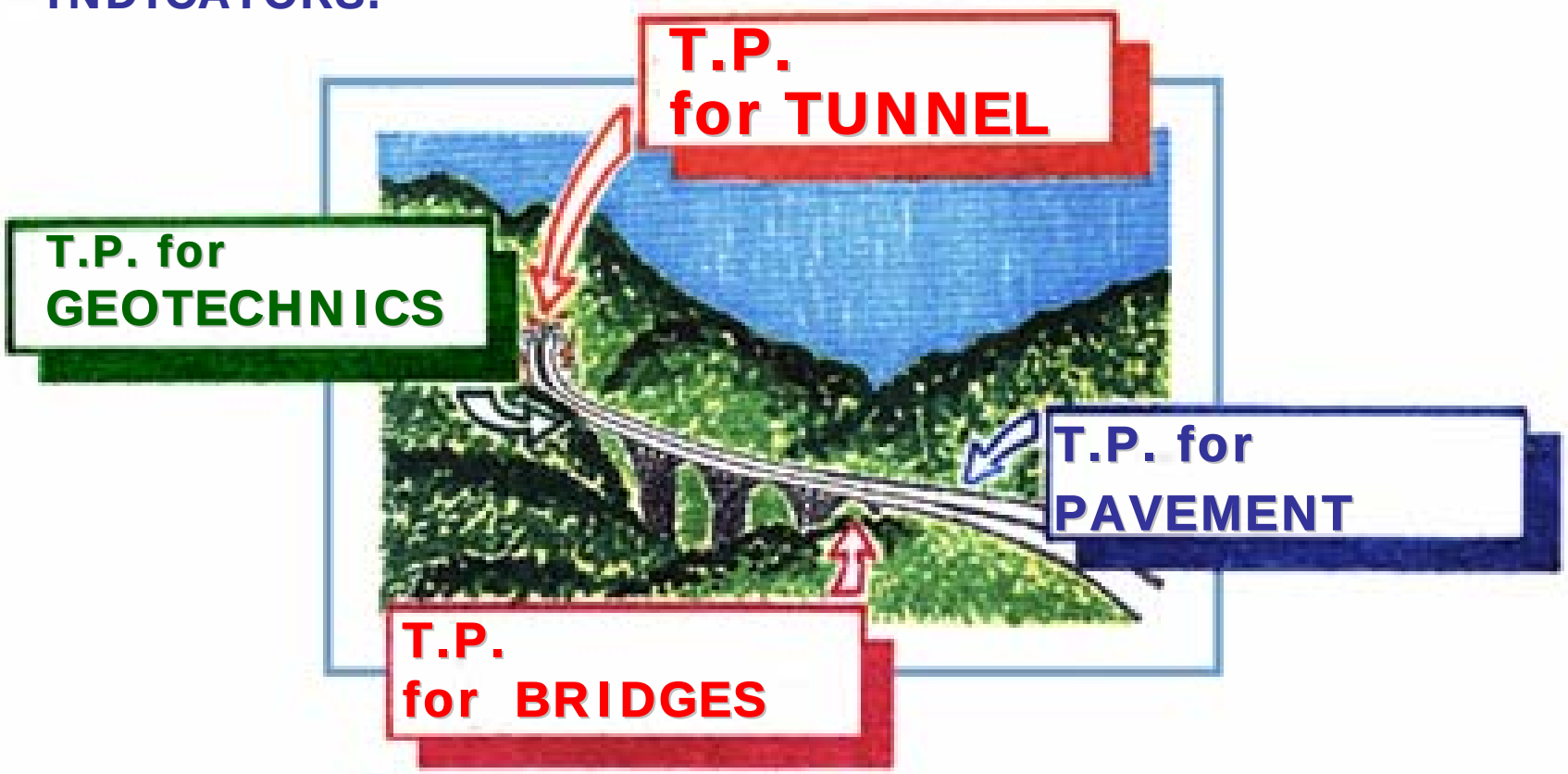
DIFFERENT TYPES TESTED



The choice: "ORGAN CANES" PAVEMENT

TEROTECHNOLOGICAL APPROACH FOR ALL PARTS OF ROAD STRUCTURES

THE SAME APPROACH USED FOR THE PAVEMENT WAS USED ON ALL PART OF ROADS, DEFINING SPECIFIC TECHNICAL PARAMETERS (T.P.) AND PERFORMANCE INDICATORS.



DIAGNOSTIC OF THE STATE AD REHABILITATION TECHNICS ARE DEVELOPED – WE SHOW PRINCIPAL RESULTS

One century of Bridges Earth Quake security

Antiseismic devices evolution

Connected to the bearing devices

1907-1960
Nothing

1960's
Sheet of lead

Only two blocks

Confined steel rolls
1960's 1970's

Weak dissipation

Bearing neoprene
Steel 1970's

Good dissipation
Low costs

Plug from
New Zealand 1970's

I MODERN EVOLUTION

Plug bearing

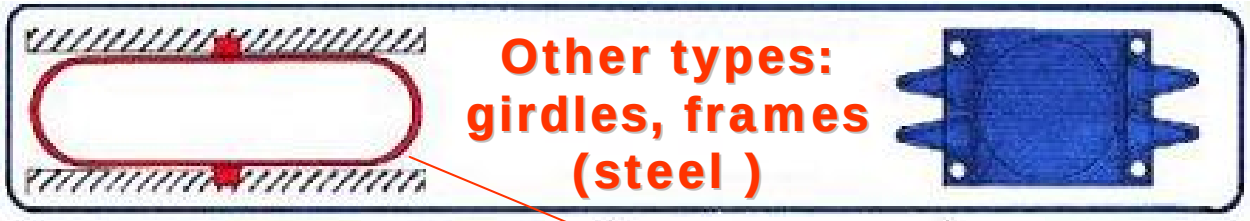
PEG DISSIPATOR
1985 Italy

Confined neoprene

One century of Bridges Earth Quake security

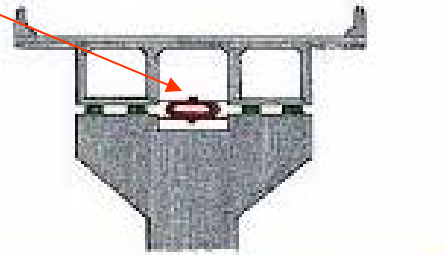
Antiseismic devices evolution From 1990 - Italy

II EVOLUTION

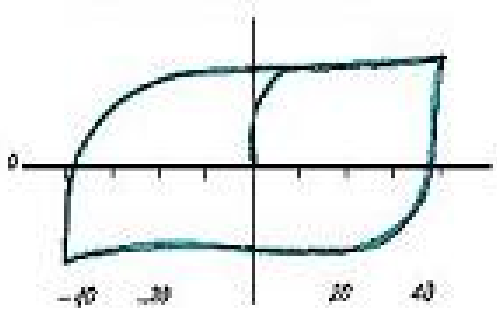


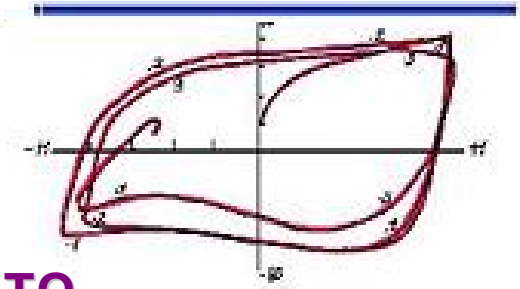
Other types: girdles, frames (steel)

Always to retrofit old bridges and also for new ones



FROM FEW CYCLES





TO

MANY CYCLES OF DISSIPATION (TOTAL REVERSIBILITY)

RESTELLO VIADUCT:0NE GIRDER

One century of Bridges Earth Quake security

Antisismic devices evolution

FROM 1990 - Italy

II EVOLUTION

Always to retrofit old bridges and also for new ones

ALL DIRECTIONS DEVICES

DEFORMABLE FRAMES

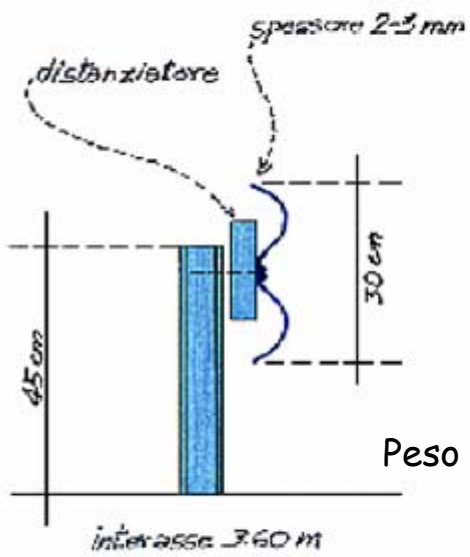
ALL DISSIPATORS REVERSIBLE

ITALIAN SAFETY BARRIERS STORY

ROAD PASSIVE SAFETY – SAFETY BARRIERS

First modern safety barriers 1964

Massive use for motorway center lane



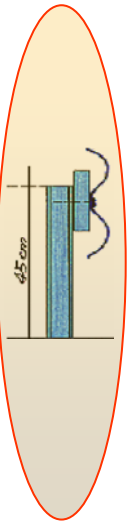
Peso 15-18 Kg/m

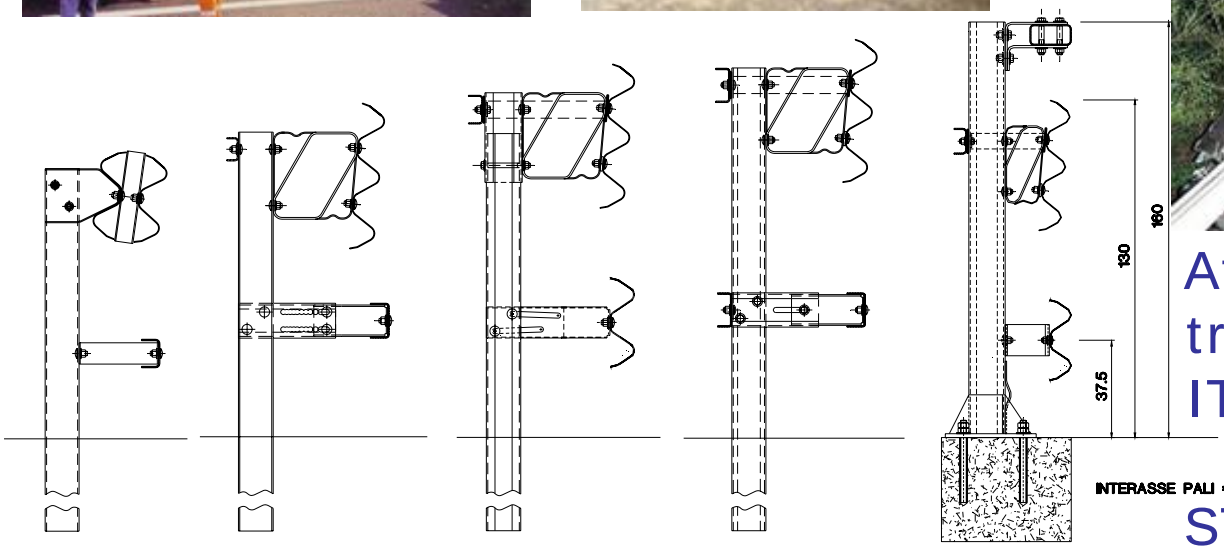
Verified in ANAS Center of CESANO 1° Italian CRASH TEST facility

NO VARIATION UNTIL 1987

ITALIAN SAFETY BARRIERS STORY

ROAD PASSIVE SAFETY – SAFETY BARRIERS





After the increase of traffic aggressiveness ITALY DEVELOPE **"BIG"** STEEL BARRIERS

H_2 H_2 H_3 H_4 H_{4BP}

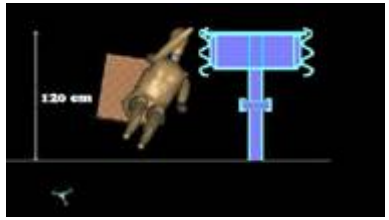
1° GENERATION with ***TRIPLE VAWE HIGH***

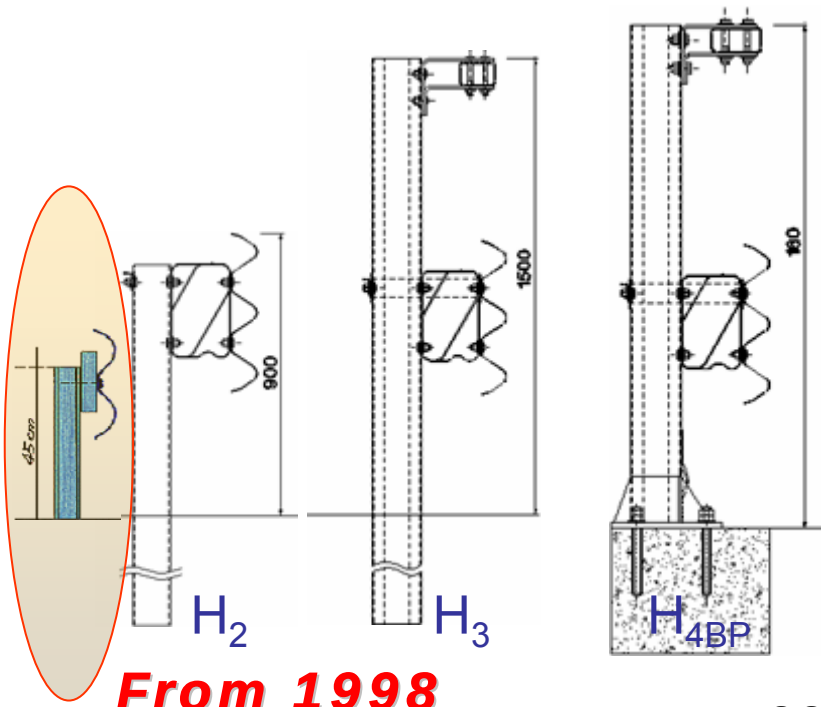
From 1990

ITALIAN SAFETY BARRIERS STORY

ROAD PASSIVE SAFETY – SAFETY BARRIERS

1° GENERATION
STEEL VAWE ARE
TOO MUCH HIGH

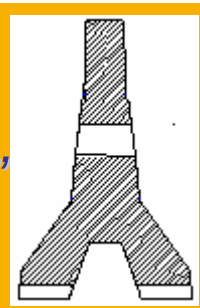




From 1998

2° GENERATION
STEEL BARRIERS
TRANSFORMED
WITH ***TRIPLE VAWE***
BEAM LOWER
(less 90 cm)

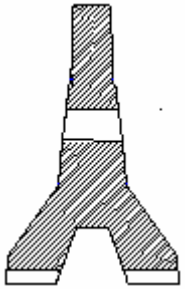
BUT THE REAL "REVOLUTION" HAS BEEN ....



ITALIAN SAFETY BARRIERS STORY

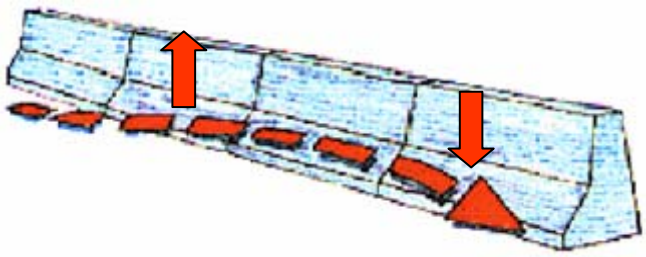
ROAD PASSIVE SAFETY – SAFETY BARRIERS

From 1985



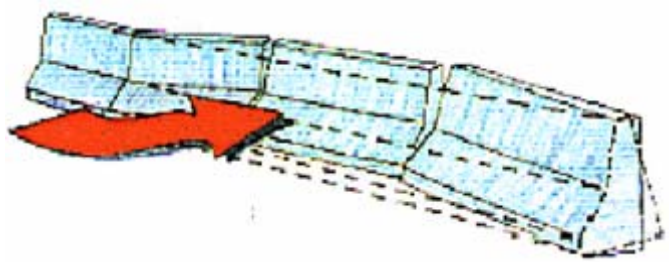
CONCRETE BARRIER NEW JERSEY PROFILE "MOVEABLE"

Dynamic control



Up – down on the barrier profile, Without vehicle and barrier damages in the low energy crashes

Moveability



For heavier crashes, the barrier moves and dissipates energy (friction on the ground)

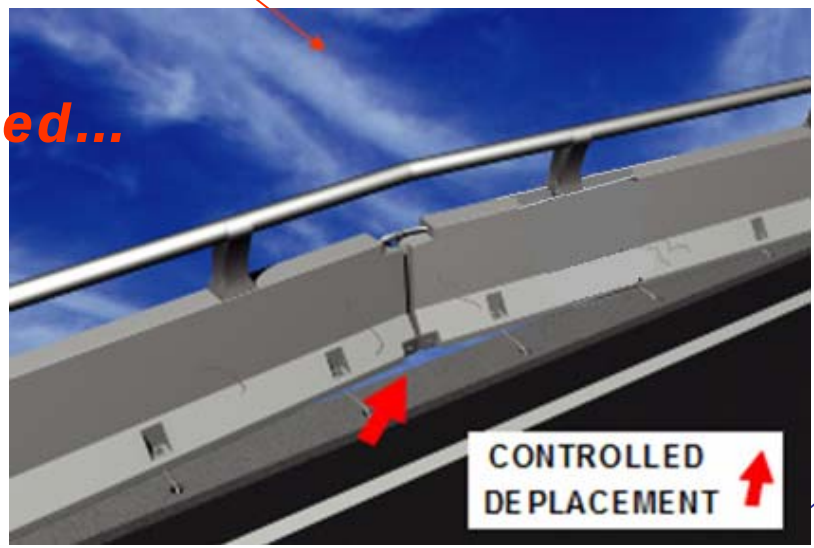
NO PROBLEMS FOR THE HEAD!!

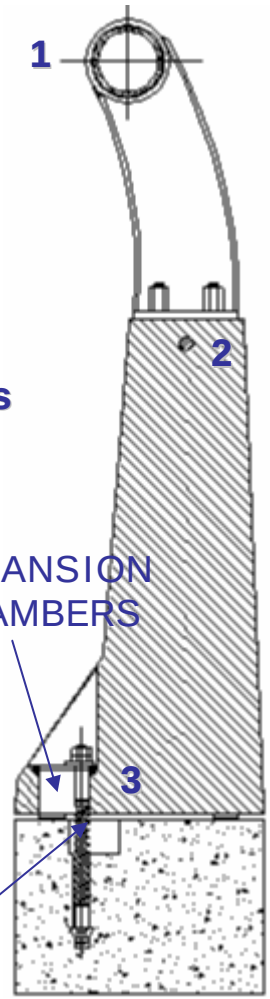
BRIDGE SAFETY MANAGEMENT

From 1990

CONCRETE BARRIER NEW JERSEY PROFILE "MOVEABLE" ALSO FOR BRIDGES

1,2,3 Retaining Devices



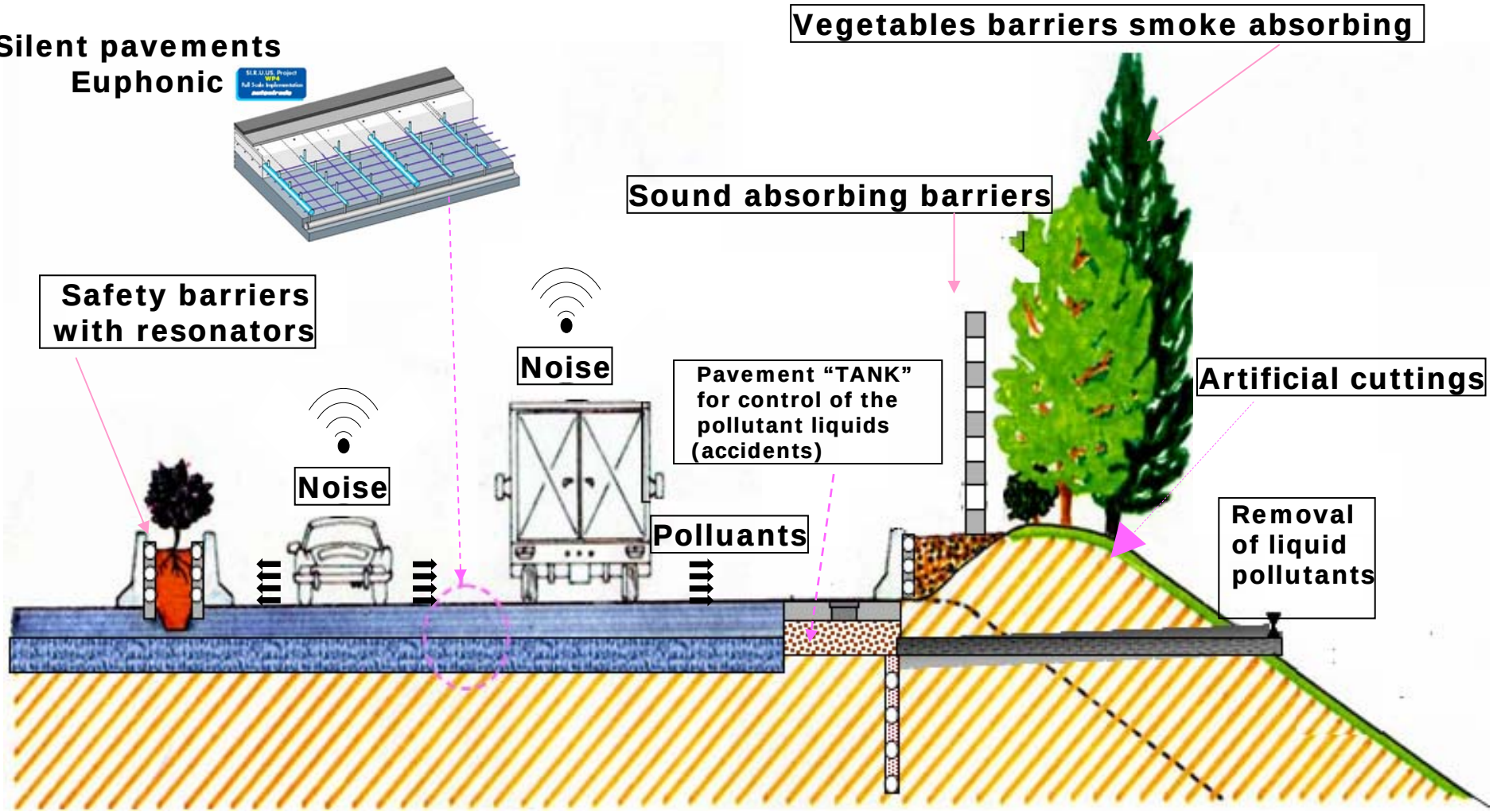


Have stopped...

the deadly falls

From 1995 - ENVIRONMENT MANAGEMENT

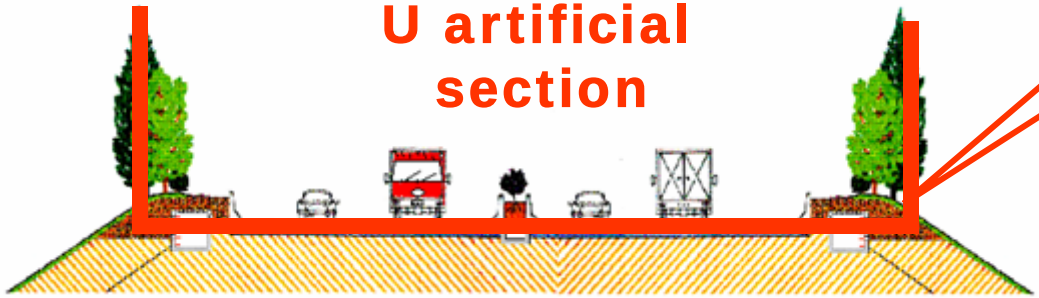
All part of the road can protect the land / environment: many solution has been developed



ENVIRONMENT MANAGEMENT

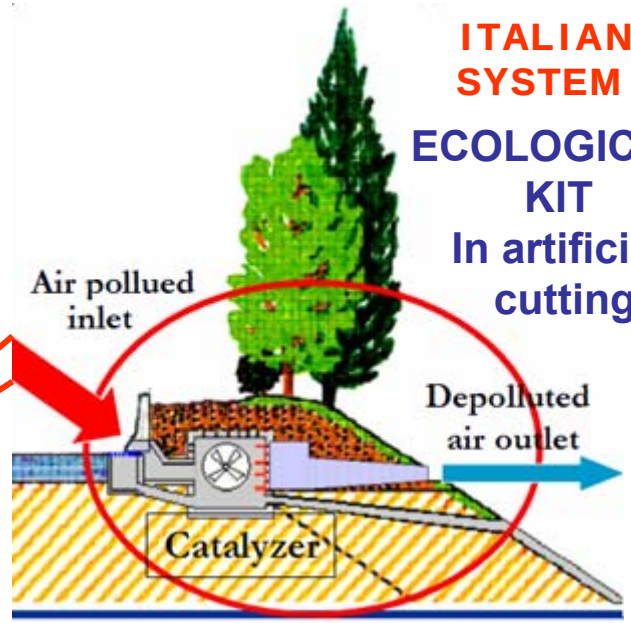
AIR POLLUTION is the last frontier of control of pollution using the elements of the road themselves.

U artificial section

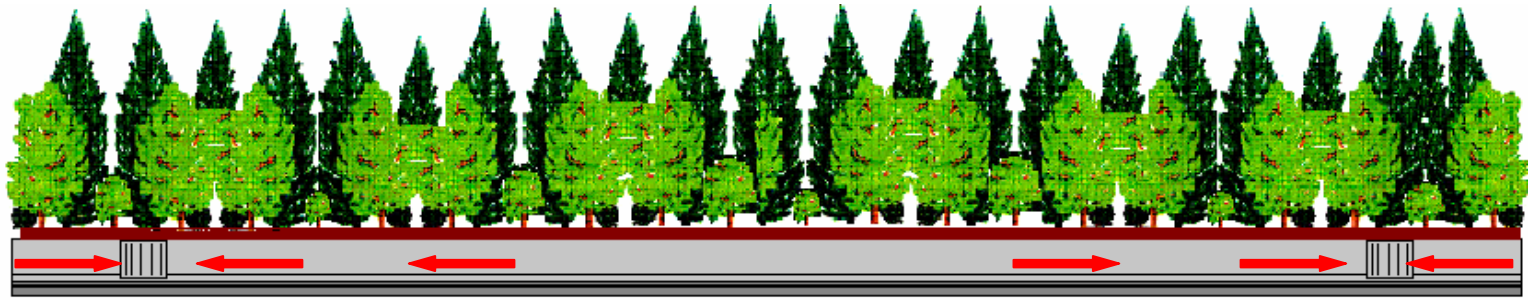


ITALIAN SYSTEM

ECOLOGICAL KIT In artificial cutting



Side view



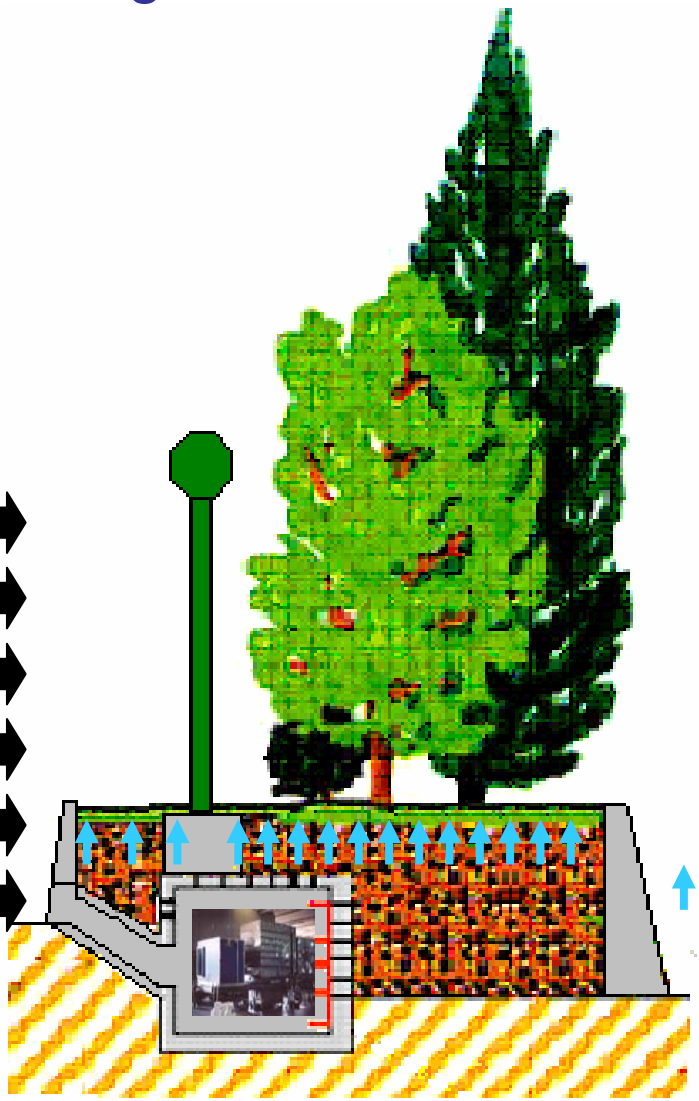
- **ACTIVE SYSTEMS (VACUUM CLEANER EQUIPPED BY CATALYST) INSTALLED IN LONGITUDINAL TUNNEL**

ENVIRONMENT MANAGEMENT ITALIAN SYSTEM

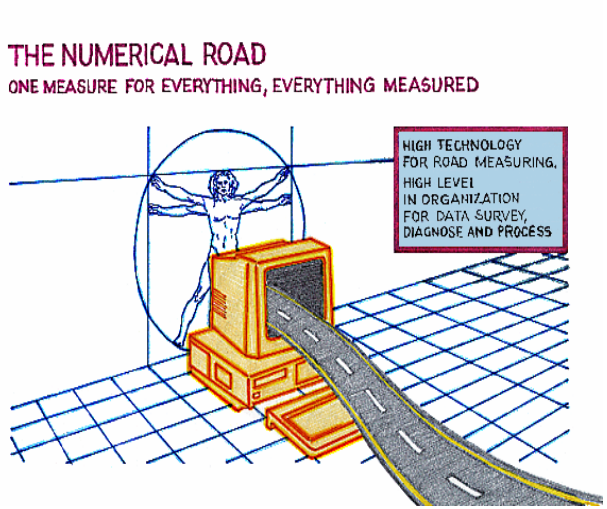
Air pollution is the last frontier of control of pollution using the elements of the road themselves.

From 2005

This
ECOLOGICAL KIT
can be inserted on side of every road section (on the cutting too)



FINAL CONSIDERATIONS



ITALIAN EXPERIENCE SHOWS THAT THE MANAGEMENT WITH MEASUREMENT IS THE BEST ONE

The PERFORMANCE INDICATORS MANAGEMENT

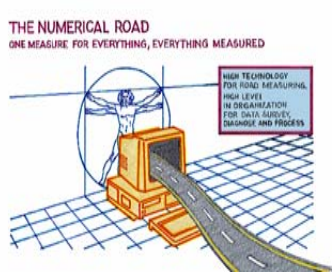
THIS APPROACH WAS USED ALSO IN ALL ACTIONS FOR THE ROAD MANAGEMENT

NOT ONLY FOR THE ROAD STRUCTURES, BUT ALSO:

- **FOR THE TRAFFIC FLOW**
- **FOR THE CUSTOMER SATISFACTION**

From 1999

PERFORMANCE INDICATORS NEEDS FOR



- **SECURITY** →

- **COMFORT** →

- **TRIP TIMES** →

- **SERVICES** →

- **ENVIRONMENT** →

QUALITY ROADS: Safe, Comfortable, Rapid, Clean and Silent

TODAY

ROAD and TRIP QUALITY are important

INFORMATION ON

- •SECURITY →
- •COMFORT →
- •TRIP TIMES →
- •SERVICES →
- •ENVIRONMENT →

MUST BE SHARED WITH THE USER.

THIS REQUIRES

INTERACTIVE MANAGEMENT

...requires MOBILITY MANAGER (M.B.)

THE PUPPETMAN

- M.B. maintains the forecast level of the Quality of the road
- M.B. measures traffic and meteorological conditions
- M.B. exchanges information between different road managers
- M.B. diffuses traffic data among the users

THIS IS THE FUTURE