



XA0300612

TEST PLANNING AND PERFORMANCE

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WORKSHOP ON
“SEISMIC DESIGN ASSESSMENT BY EXPERIMENTAL METHODS”

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TEST PLANNING AND PERFORMANCE

NATIONAL WORKSHOP

“Seismic Design Assessment by Experimental Methods”

NPIC – CHENGDU

September 10-14, 2001

TEST PLANNING AND PERFORMANCE

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1. TEST PLANNING

1.1. Testing plan

1.1.1. Safety guide Q4 - Inspection and testing - A **testing plan** should be prepared including following information:

- General information (facility name, item or system reference, procurement document reference, document reference number and status, associated procedures and drawings);
- A sequential listing of all testing activities;
- Procedure, work instruction, specification or standard to be followed in respect of each operation and test;
- Acceptance criteria;
- Identification of who is performing tests;
- Identification of hold points;
- Type of records to be prepared for each test;
- Persons and organizations having authority for final acceptance.

1.1.2. Activities sequence:

- VISUAL, ELECTRICAL AND MECHANICAL CHECKS
- ENVIRONMENTAL TESTS (THERMAL AGING, VIBRATIONS AGING, RADIOACTIVE AGING)
- PERFORMANCES EVALUATION IN EXTREME CONDITIONS
- DYNAMIC TESTS WITH FUNCTIONAL CHECKS
- FINAL ELECTRICAL AND MECHANICAL CHECKS

1.2. Major steps

1.2.1. The planning of the tests should always be performed taking into account an interpretative model: a very tight cooperation is advisable between experimental people and numerical people dealing with the analysis of more or less complex models for the seismic assessment of structures and components.

1.3. Preparatory phase

1.3.1. The choice of the following items should be agreed upon with the final user of the tests:

- Excitation points
- Excitation types
- Excitation amplitude with respect to frequency
- Measuring points

TEST PLANNING AND PERFORMANCE

- Type of measurements (accelerations, displacements, strain gages, forces)
- 1.3.2. Data acquisition, recording and storage, should take into account the characteristics of the successive data processing: too much data can be cumbersome to be processed, but too few data can make unusable the experimental results.
- The parameters for time history acquisition should be chosen taking into account data processing: for Shock Response Spectrum calculation some special requirements should be met: frequency bounded signal, high frequency sampling, shock noise.
 - For stationary random-like excitation, the sample length should be chosen taking into account errors tolerances.

2. TEST PERFORMANCE

2.1. Test procedures should be prepared and issued.

2.2. Management of unexpected behaviours.

2.2.1. Non linear behaviour

2.2.2. Shocks among mechanical parts in presence of clearances.

2.3. On line controls

2.3.1. Alarm limits

2.3.2. Abort limits

2.3.3. Interlocks

EXPERIMENTAL METHODS

*** TEST EQUIPMENT**

- SIX DEGREES OF FREEDOM SHAKING TABLES
- DIMENSIONS AND PERFORMANCES
- SPURIOUS MOTION CONTROL AND REPRODUCIBILITY OF THE REQUIRED MOTION
- DYNAMIC TESTS WITH FUNCTIONAL CHECKS

*** TEST PROCEDURES**

- LOW AMPLITUDE TESTS (FREQUENCY RESPONSE INVESTIGATION AND SHAKING TABLE TUNING)
- QUALIFICATION TESTS (OBTAINED QUALIFICATION AMPLITUDE OR STEP TESTS)
- FRAGILITY TESTS

*** SPECIMEN MOUNTING**

- EVALUATION OF THE RESTRAINT SYSTEM
- AVOIDANCE OF UNWANTED AMPLIFICATIONS
- MOUNTING CONDITION DEPENDENCE (GEOMETRY, SCREW TORQUE)

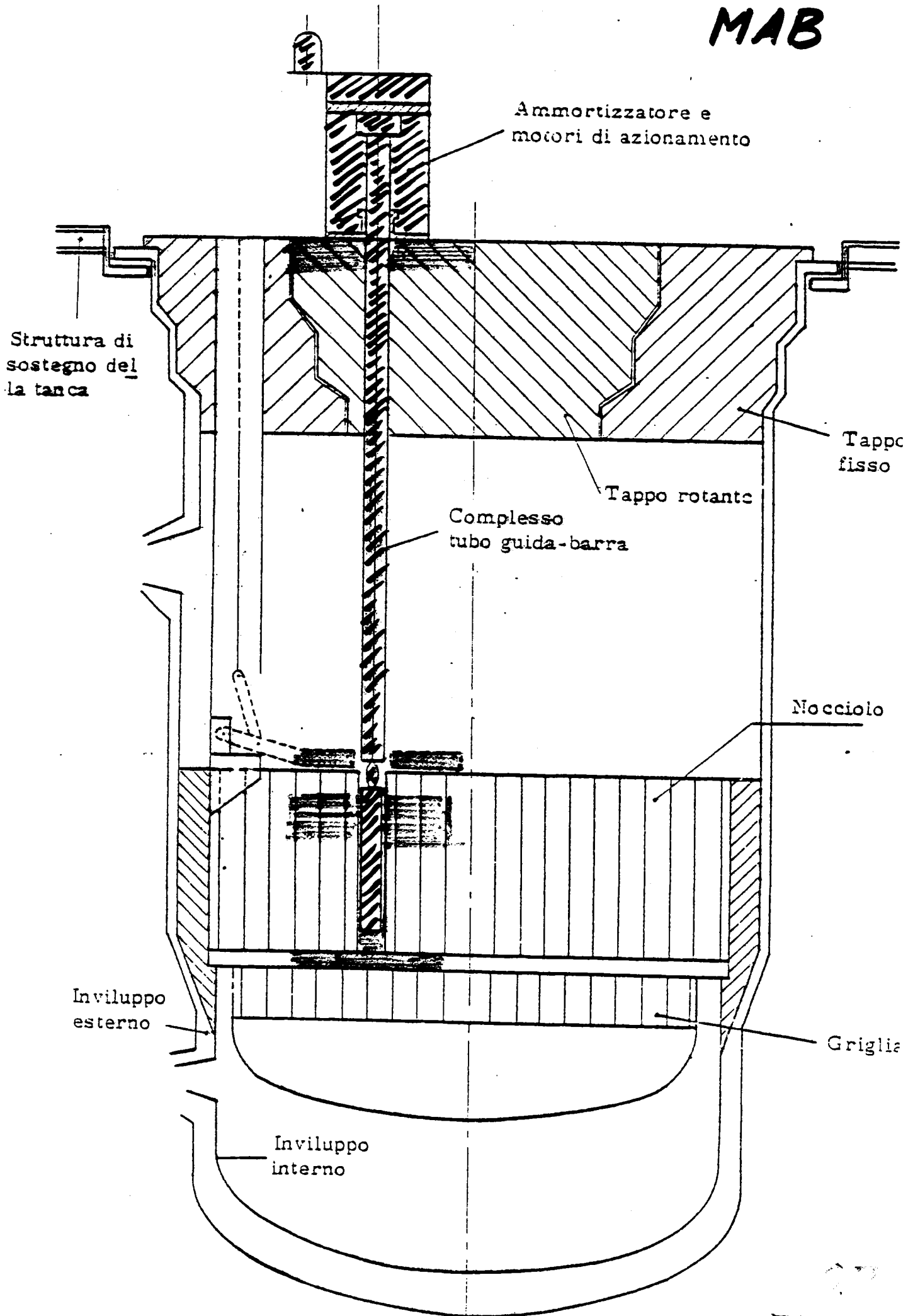
*** DATA ACQUISITION**

- ACCELERATION TRANSDUCERS AND STRAIN GAGES
- ELECTRICAL DEVICES FOR OPERABILITY

Author: M. Zola

SCHEMA DEL MUCCIOLU DEL REATTURE

MAB



PROVE SUL SIMULACRO DEL
MECCANISMO AZIONAMENTO BARRE
DEL REATTORE PEC

▼ 11.12

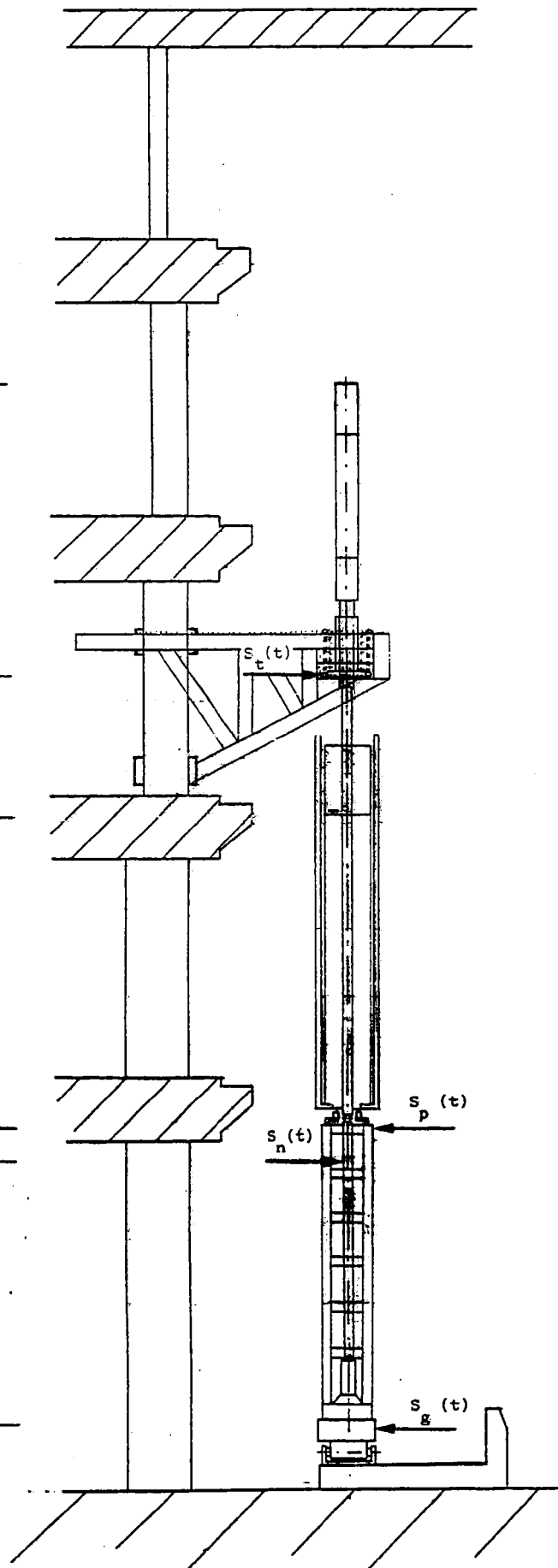
▼ 8.29

▼ 6.35

▼ 3.00

▼ 2.56

▼ 0.00



quota tappo rotante

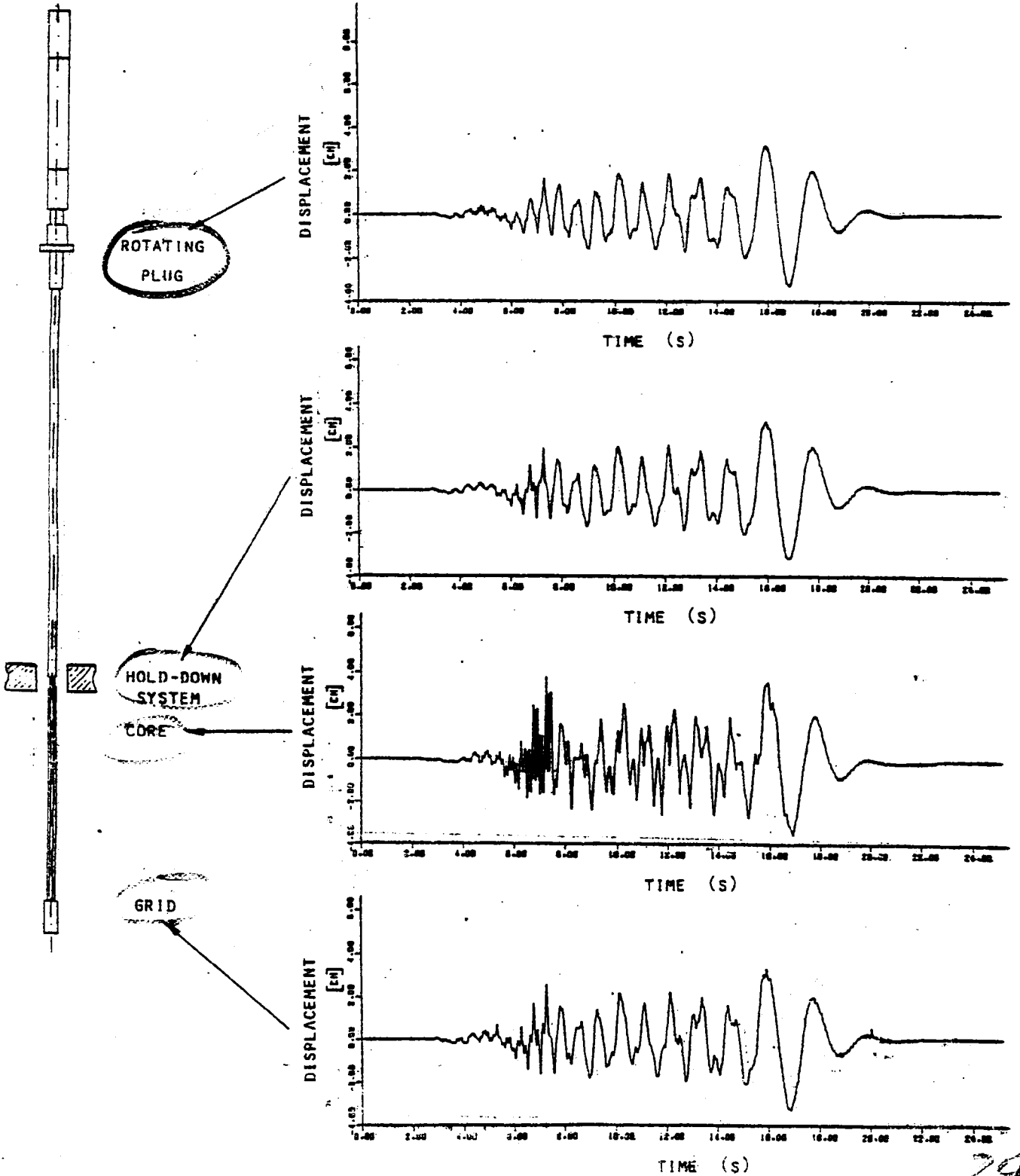
quota petalo

quota nocciolo

quota griglia

SEISMIC TESTS ON THE PEC SHUTDOWN SYSTEM (MAB)

IMPOSED EXCITATIONS



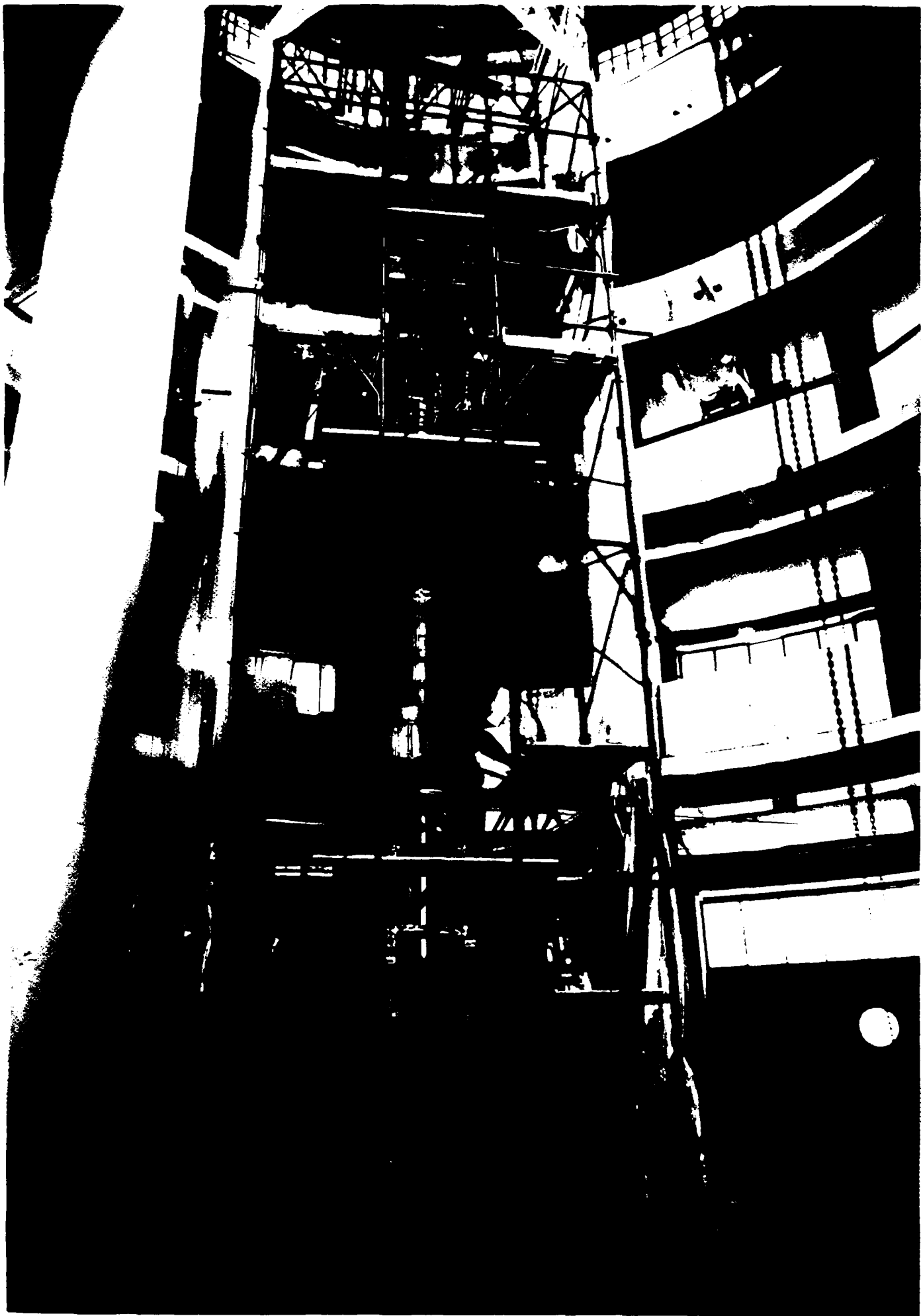


Fig. 2.5.3: Dynamic tests on a mock-up of the PEC shutdown system (II series)
the test rig

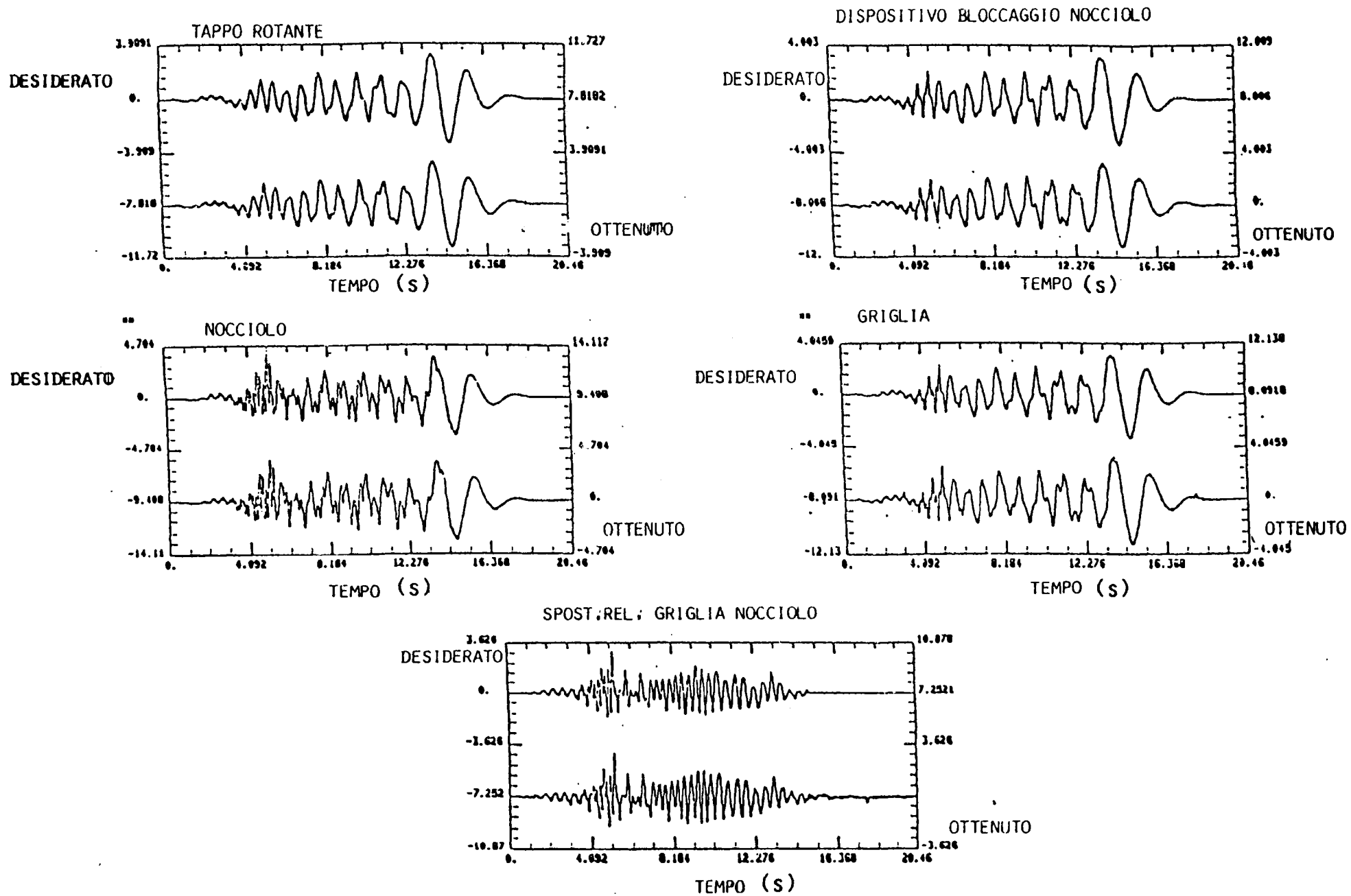


FIG. 17: CONFRONTO TRA GLI OSCILLOGRAMMI DESIDERATI E OTTENUTI (SPOSTAMENTI IN CM)

EXCITATION TYPES

- MONOFREQUENCY EXCITATION:

- SINUSOIDAL MOTION

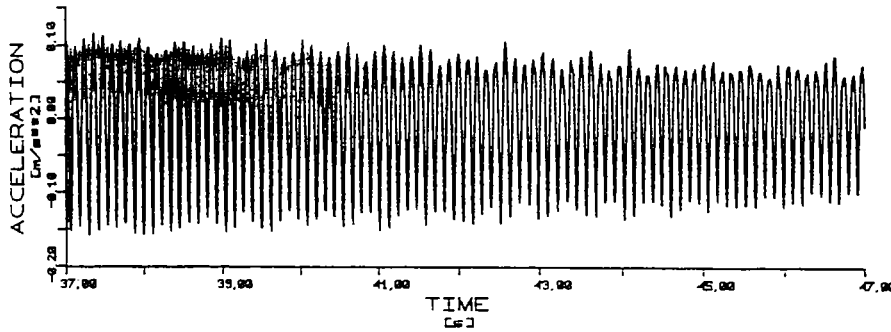
- MULTIFREQUENCY EXCITATION:

- RANDOM MOTION

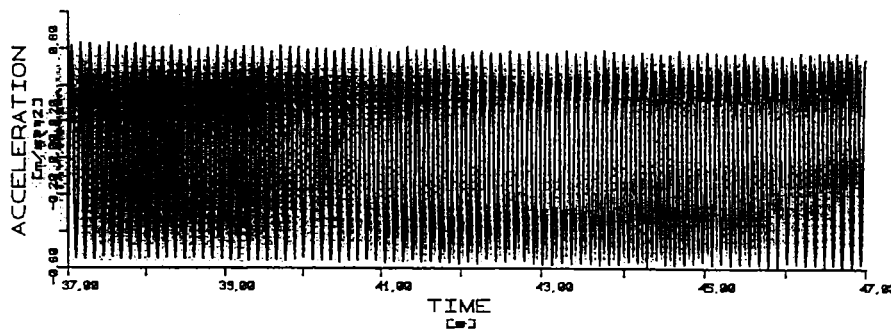
- TRANSIENT MOTION

SINUSOIDAL EXCITATION

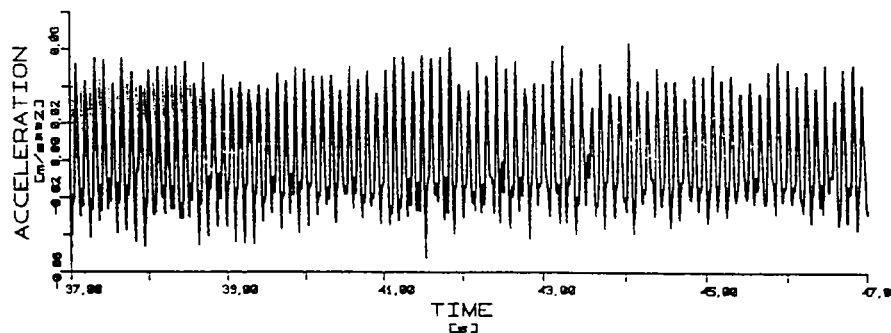
TIME DOMAIN



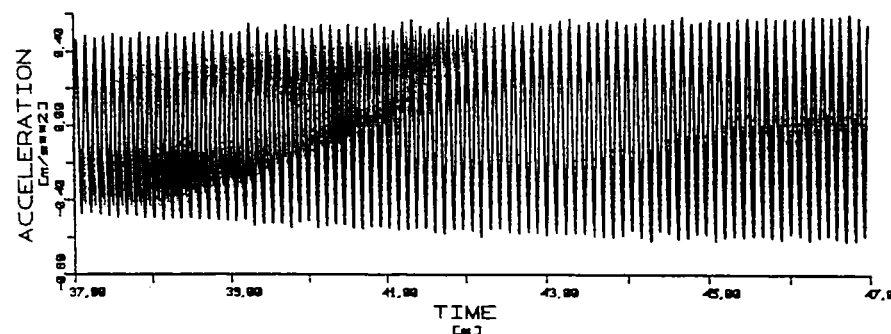
SIEMENS 245 KV G. I. S. CANUTILLAR PROJECT
E 1 P 9 S 2
SINUSOIDAL TEST
TEST N. 9
POS. 11
TIME HISTORY



SIEMENS 245 KV G. I. S. CANUTILLAR PROJECT
E 1 P 9 S 3
SINUSOIDAL TEST
TEST N. 9
POS. 12
TIME HISTORY



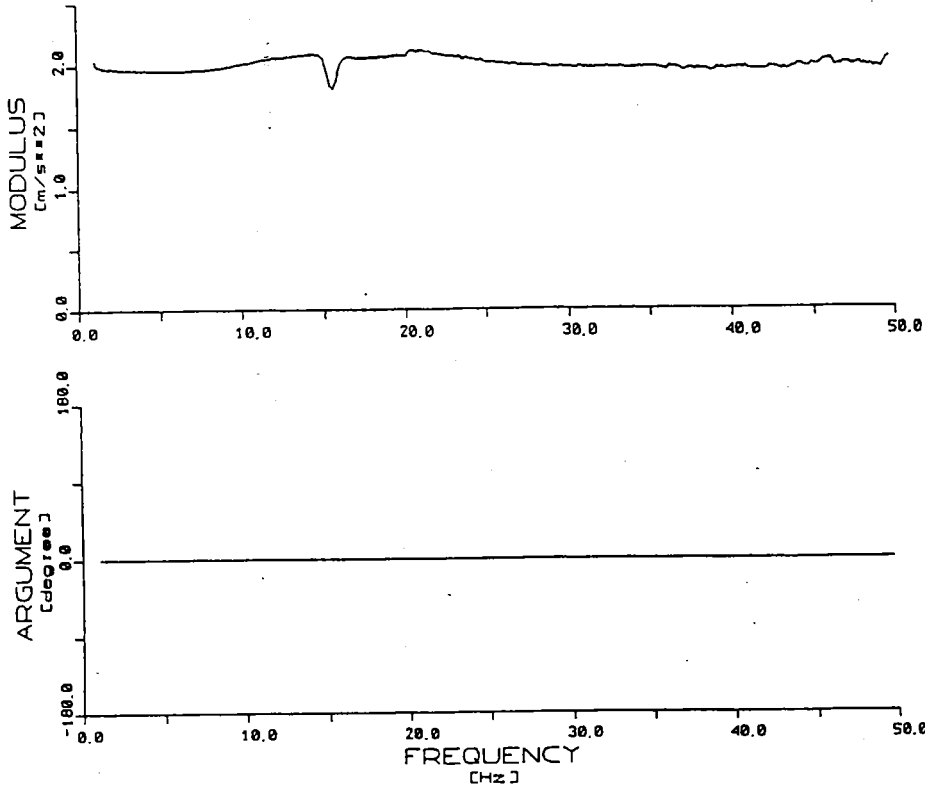
SIEMENS 245 KV G. I. S. CANUTILLAR PROJECT
E 1 P 9 S 4
SINUSOIDAL TEST
TEST N. 9
POS. 13
TIME HISTORY



SIEMENS 245 KV G. I. S. CANUTILLAR PROJECT
E 1 P 9 S 5
SINUSOIDAL TEST
TEST N. 9
POS. 22
TIME HISTORY

SINUSOIDAL EXCITATION

FREQUENCY DOMAIN



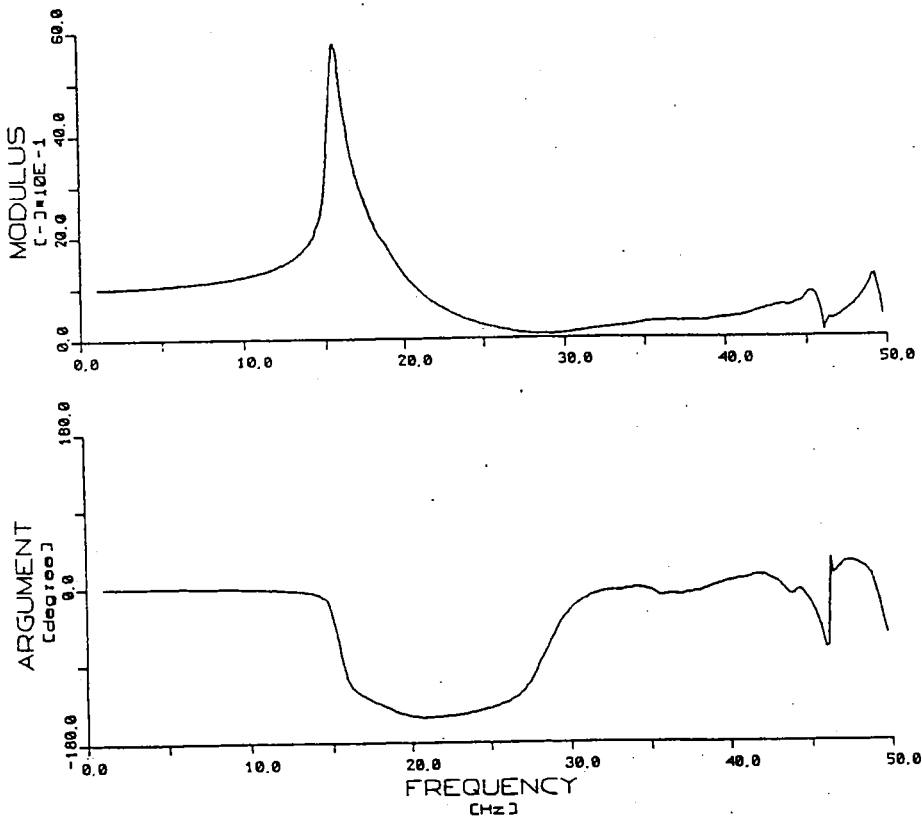
SEISMIC QUALIFICATION TESTS
 FOR TEMPLIN MONITORING
 AND DIAGNOSTICS SYSTEMS
 (TMS)

C 2 P 1 S A2

TEST N 2 - INITIAL SINE SWEEP

Y AXIS - SWEEP UP

Pos. A2



SEISMIC QUALIFICATION TESTS
 FOR TEMPLIN MONITORING
 AND DIAGNOSTICS SYSTEMS
 (TMS)

E 2 P 1 S P05

TEST N 2 - INITIAL SINE SWEEP

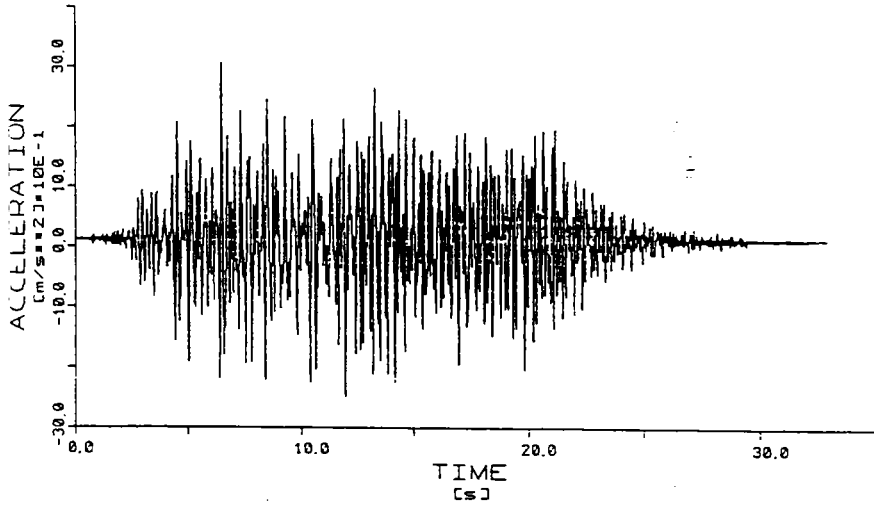
Y AXIS - SWEEP UP

TRANSFER FUNCTION
 POS. A5

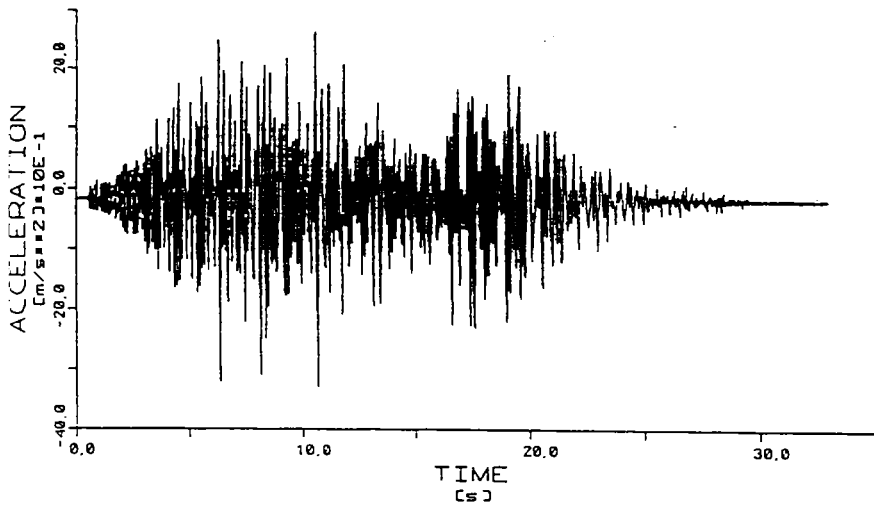
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TRANSIENT EXCITATION

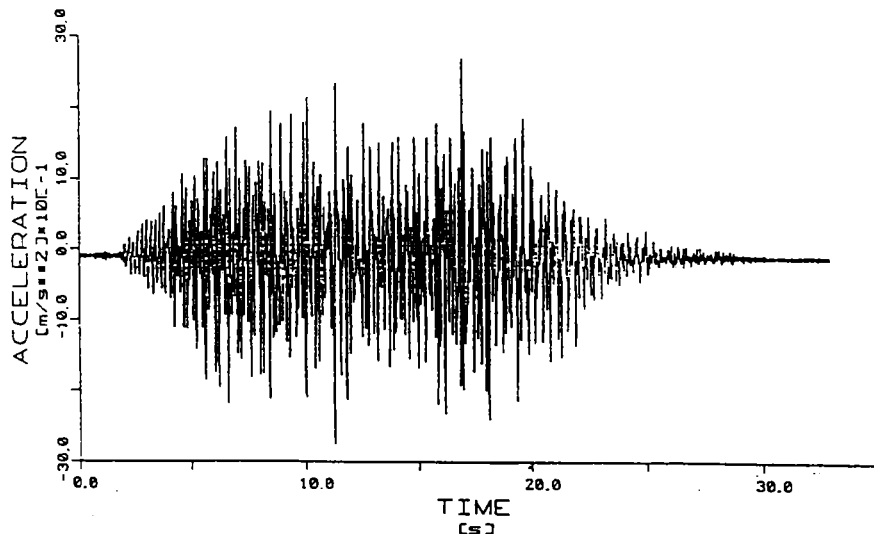
SEISMIC TIME HISTORY



SEISMIC QUALIFICATION TESTS FOR TEMELIN MONITORING AND DIAGNOSTICS SYSTEMS (TMS)
E 4 P 1 S A1
TEST N 4 - SEISMIC QUALIF
1st TEMELIN OBE
TIME HISTORY POS A1



SEISMIC QUALIFICATION TESTS FOR TEMELIN MONITORING AND DIAGNOSTICS SYSTEMS (TMS)
E 4 P 1 S A2
TEST N 4 - SEISMIC QUALIF
1st TEMELIN OBE
TIME HISTORY POS A2



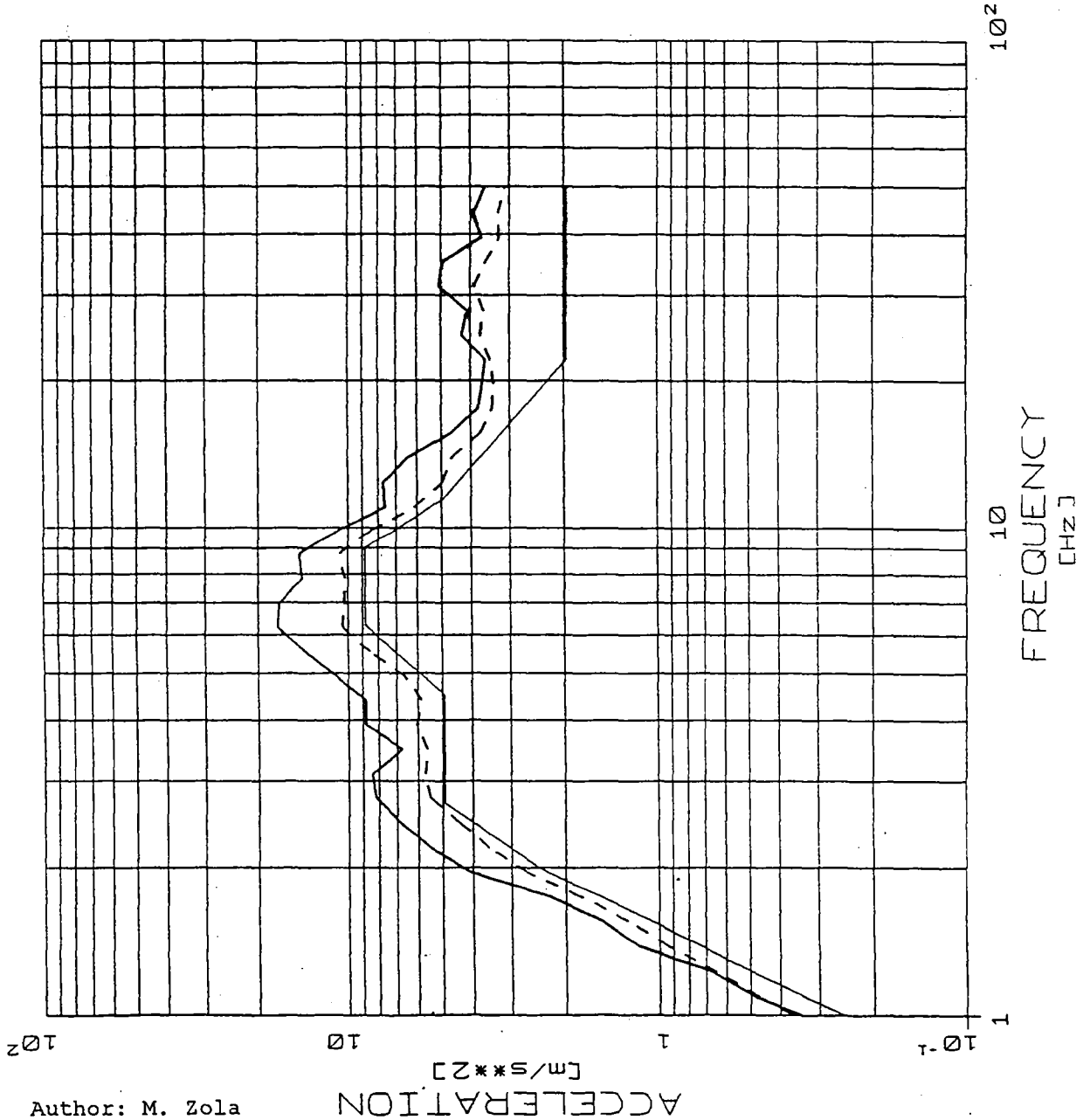
SEISMIC QUALIFICATION TESTS FOR TEMELIN MONITORING AND DIAGNOSTICS SYSTEMS (TMS)
E 4 P 1 S A3
TEST N 4 - SEISMIC QUALIF
1st TEMELIN OBE
TIME HISTORY POS A3

Author: M. Zola

TRANSIENT EXCITATION

FREQUENCY DOMAIN

SEISMIC QUALIFICATION TESTS FOR TELELIN MONITORING AND DIAGNOSTICS SYSTEMS (TMO5)		E 90	P 1	S 108E71	RRS
E 4	P 1	S A103	TRS (2% damping)		
E 4	P 1	S A203	TRS (5% damping)		
SHOCK SPECTRUM TEST N.4 1st OBE POS. A3					



ECCITAZ. TRANS.
ES. DI FLABORAZ.

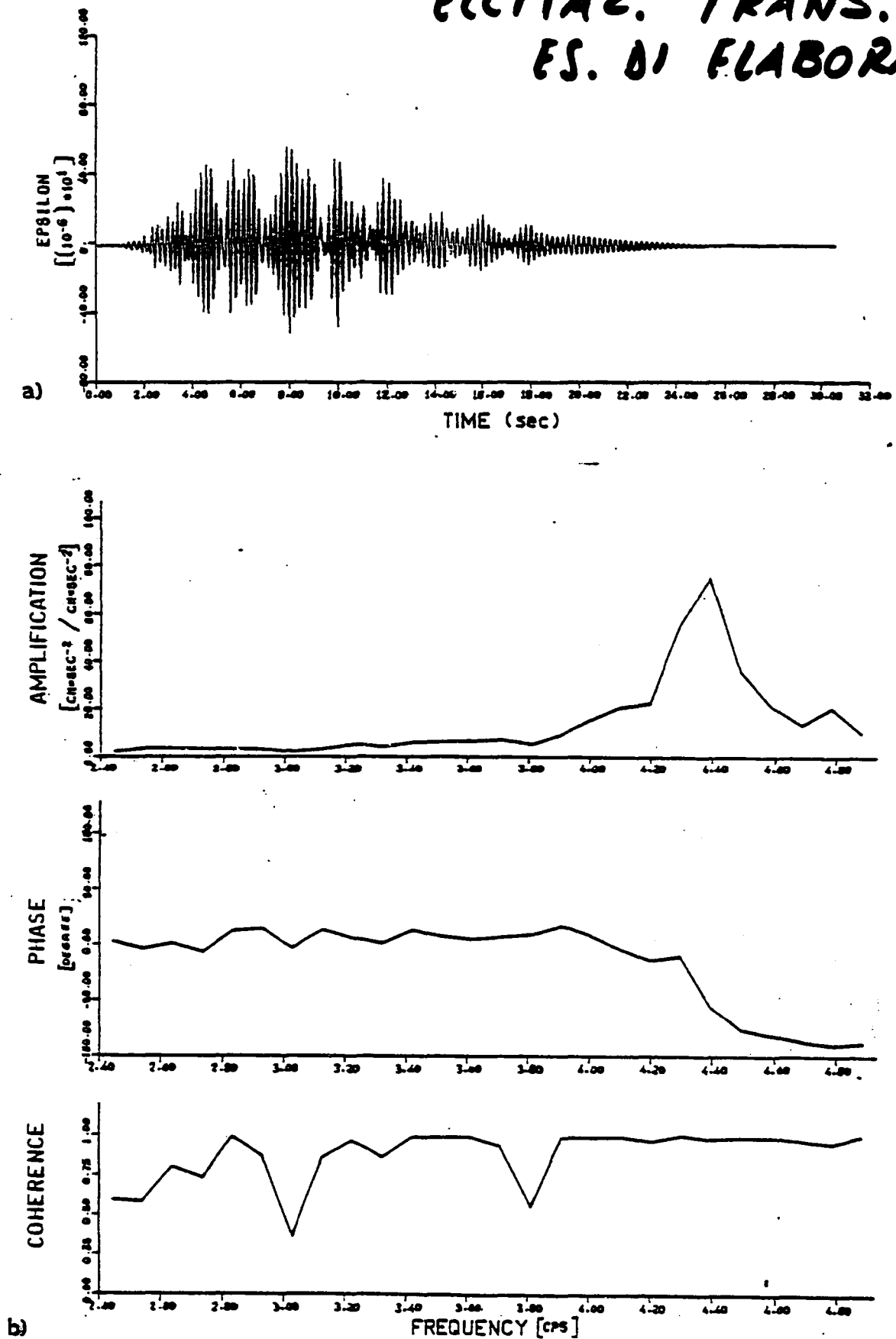
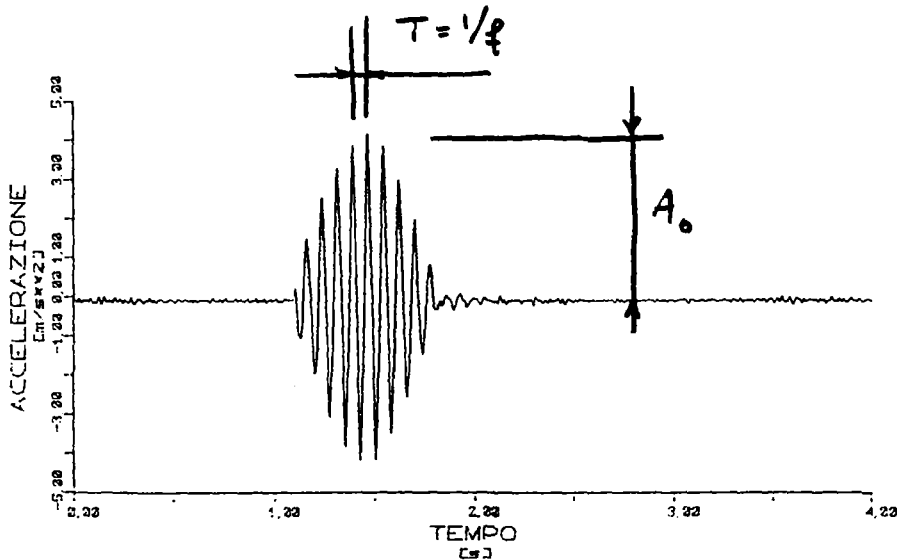


Fig. 9: Shock test on simplified models:

- a) Response of a strain gauge at the foot.
- b) Frequency response function of the couple.

13
10



Prove di Qualifica
 Sismiche su un
 quadro M2
 Modello 76

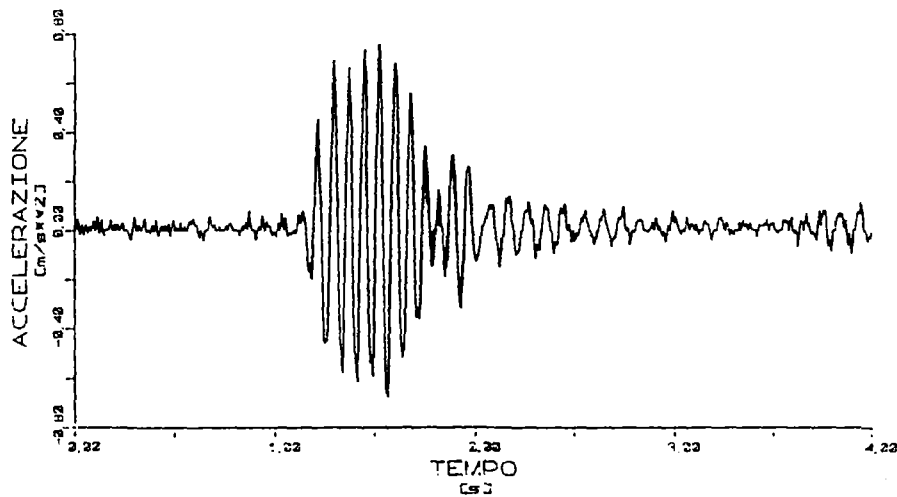
E 2 P 14 S 23

BATTIMENTO SINUSOIDALE

PROVA N. 14, DIREZIONE Z

n. 13 Hz, battimento 5

OSCILLOGRAMMA
 PDS. 23



Prove di Qualifica
 Sismiche su un
 quadro M2
 Modello 76

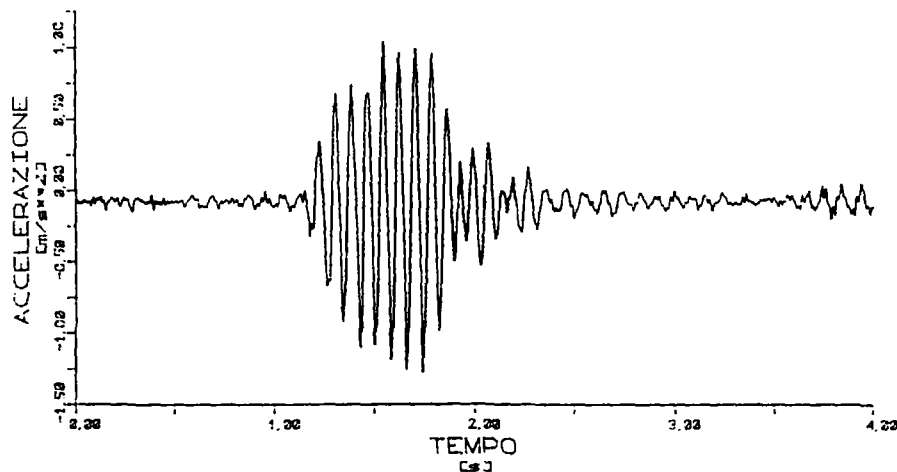
E 2 P 14 S 31

BATTIMENTO SINUSOIDALE

PROVA N. 14, DIREZIONE Z

n. 13 Hz, battimento 5

OSCILLOGRAMMA
 PDS. 31



Prove di Qualifica
 Sismiche su un
 quadro M2
 Modello 76

E 2 P 14 S 41

BATTIMENTO SINUSOIDALE

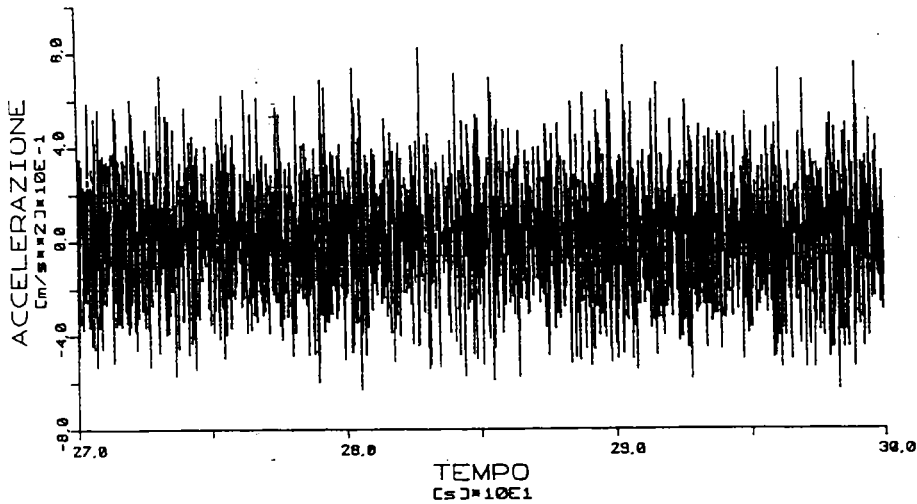
PROVA N. 14, DIREZIONE Z

n. 13 Hz, battimento 5

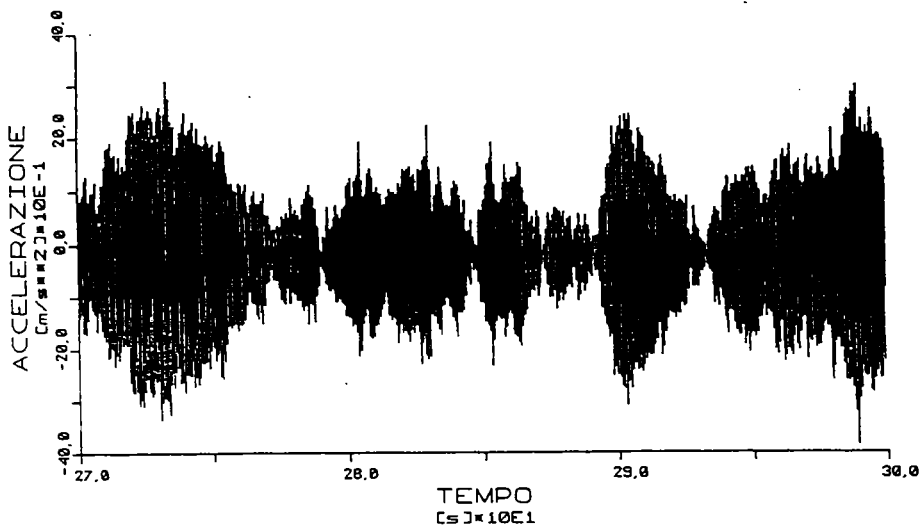
OSCILLOGRAMMA
 PDS. 41

RANDOM EXCITATION

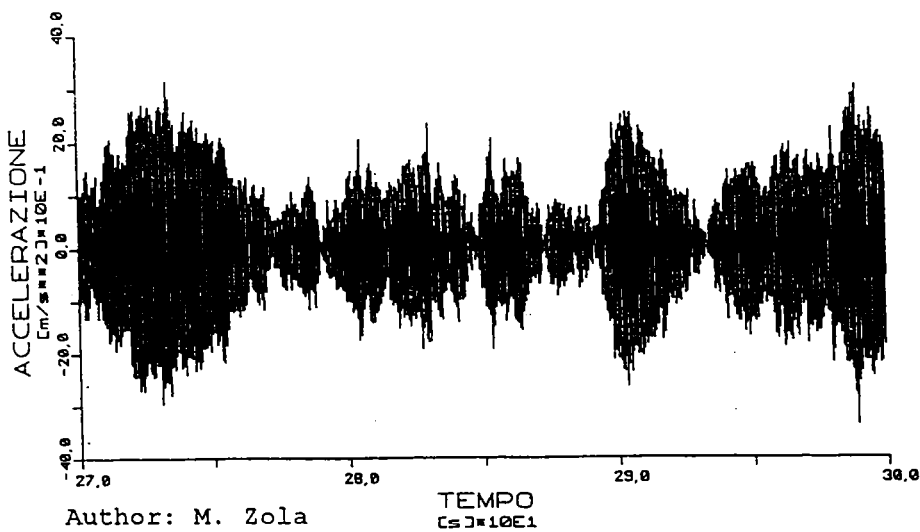
TIME DOMAIN



VERIFICA SISMICA STAZIONE 300 kV CON ISOLAMENTO IN ARIA TRASFORMATORE DI CORRENTE ABB ADDA
E RAI P 7 S EPFZ CARATTERIZZAZIONE DINAMICA PROVA N. 7 - DIR Y
OSCILLOGRAMMA Pos. A1Y



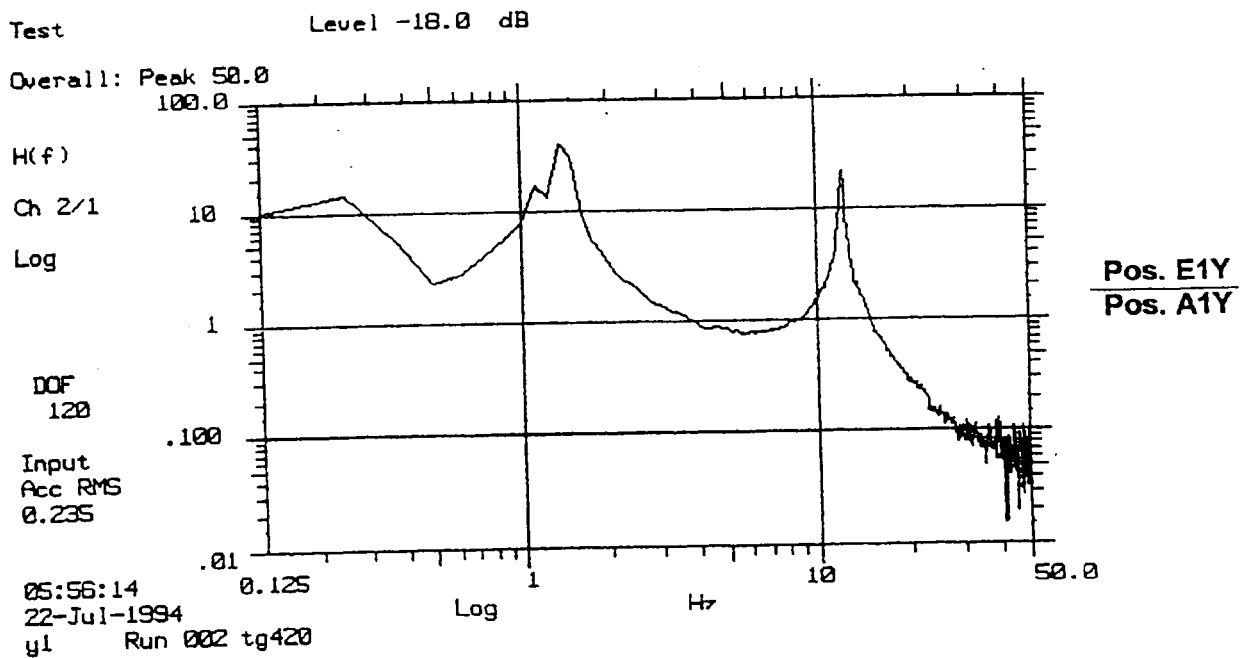
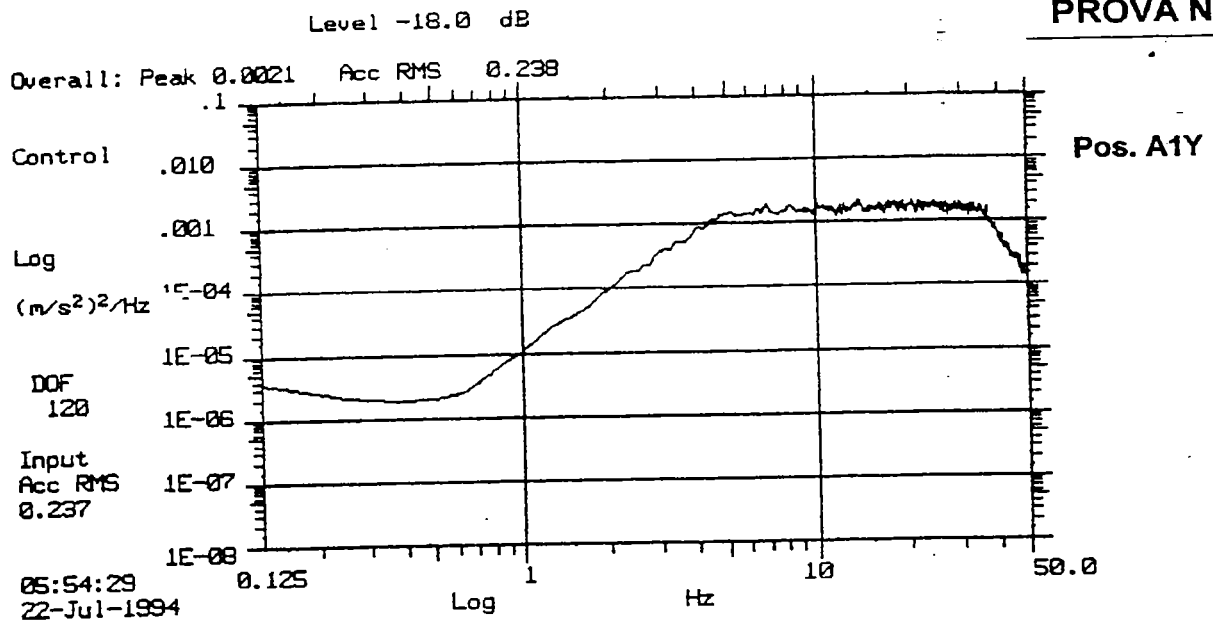
VERIFICA SISMICA STAZIONE 300 kV CON ISOLAMENTO IN ARIA TRASFORMATORE DI CORRENTE ABB ADDA
E RAI P 7 S EPFS CARATTERIZZAZIONE DINAMICA PROVA N. 7 - DIR Y
OSCILLOGRAMMA Pos. A2Y



VERIFICA SISMICA STAZIONE 300 kV CON ISOLAMENTO IN ARIA TRASFORMATORE DI CORRENTE ABB ADDA
E RAI P 7 S EPF7 CARATTERIZZAZIONE DINAMICA PROVA N. 7 - DIR Y
OSCILLOGRAMMA Pos. A3Y

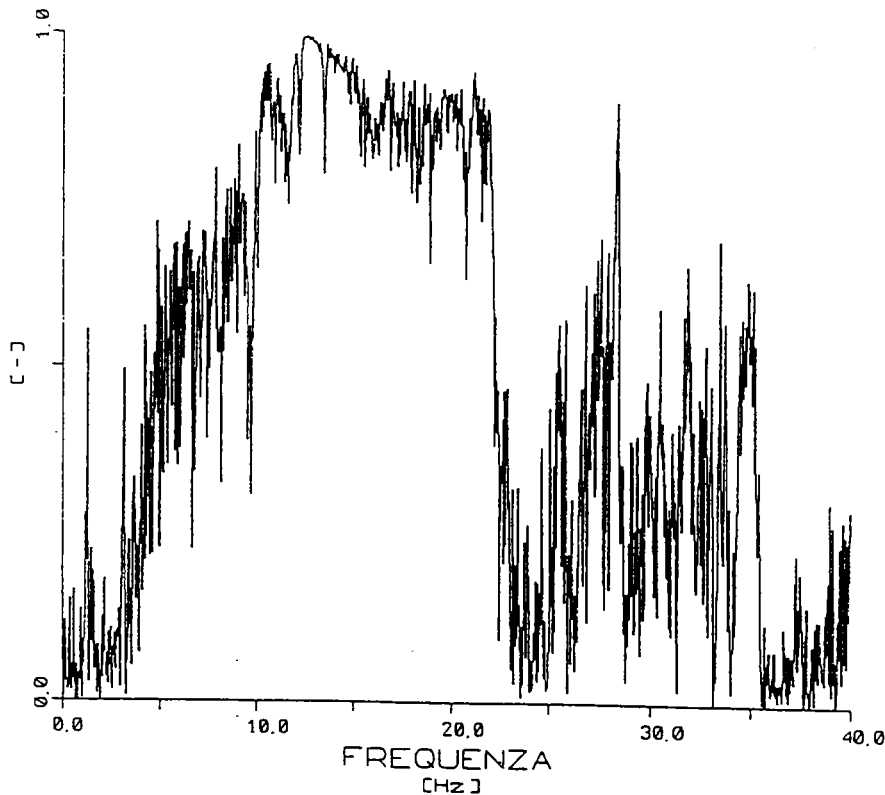
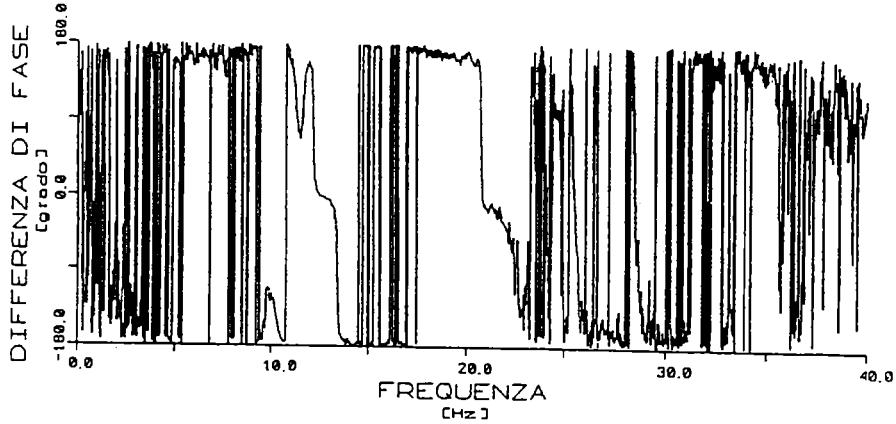
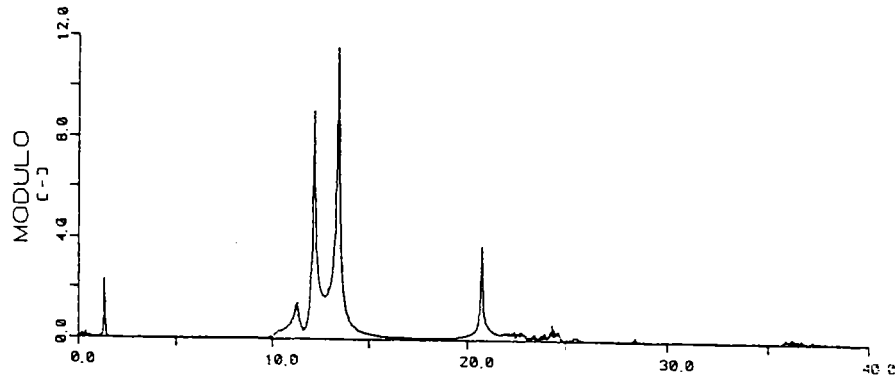
Author: M. Zola

RANDOM EXCITATION FREQUENCY DOMAIN



RANDOM EXCITATION

FREQUENCY DOMAIN



VERIFICA SISMICA STAZIONE 380 kV CON ISOLAMENTO IN ARIA TRASFORMATORE DI CORRENTE ABB ADDA
E RA1 P 7 S 306 CARATTERIZZAZIONE DINAMICA PROVA N 7 - DIR Y
FUNZIONE DI TRASFERIMENTO POS ASX

VERIFICA SISMICA STAZIONE 380 kV CON ISOLAMENTO IN ARIA TRASFORMATORE DI CORRENTE ABB ADDA
E RA1 P 7 S 406 CARATTERIZZAZIONE DINAMICA PROVA N 7 - DIR Y
FUNZIONE DI COERENZA POS ASX

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