EIB

Stabilization:

Actual situation
Possibilities
Implications

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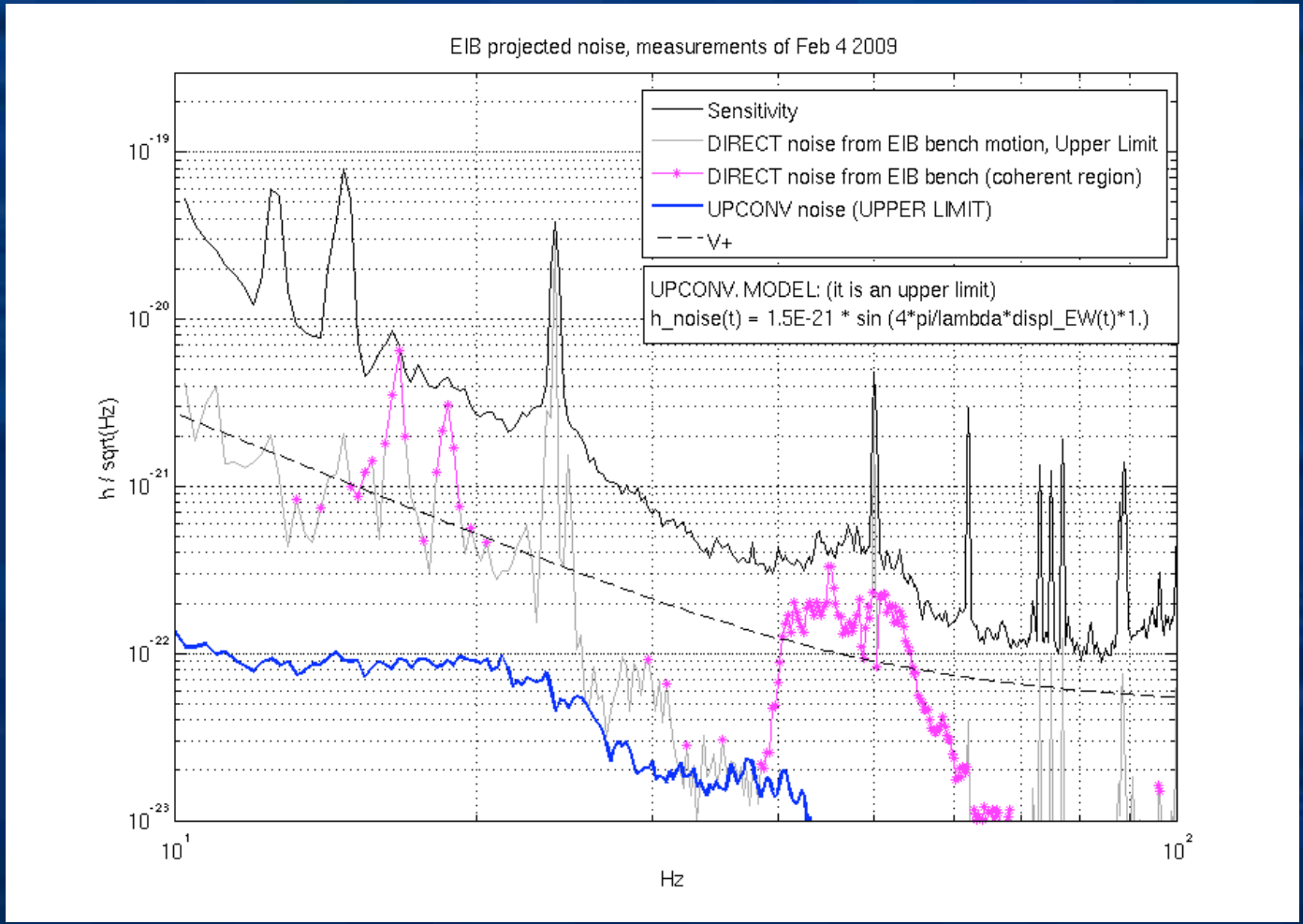
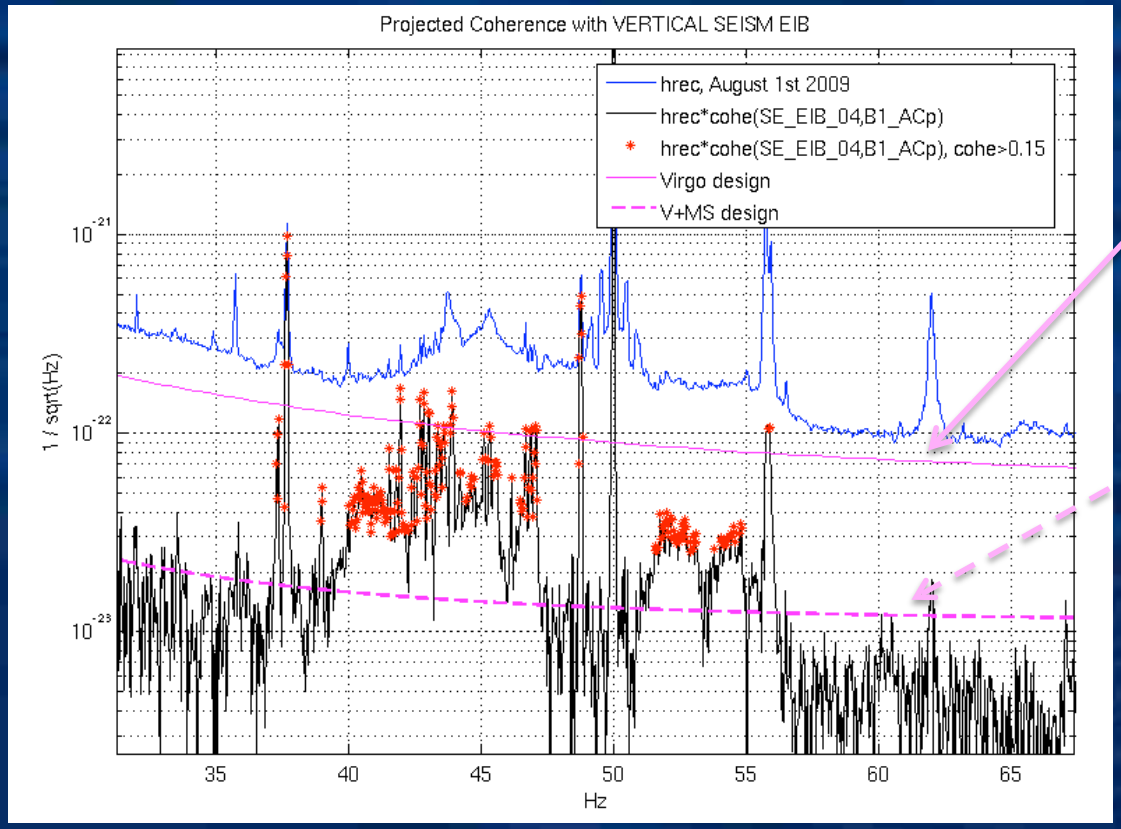
Eric Hennes, David Rabeling, Th. S. B.

Projection of coherence



Projection of coherence - vertical



- Oscillation of EIB important noise for Virgo Sensitivity between 18 and 60 Hz
- V+MS has ~10 X better sensitivity
- each noise source 10 X less than projected sensitivity
- **need factor ~100 better damping between 18 and 60 Hz**

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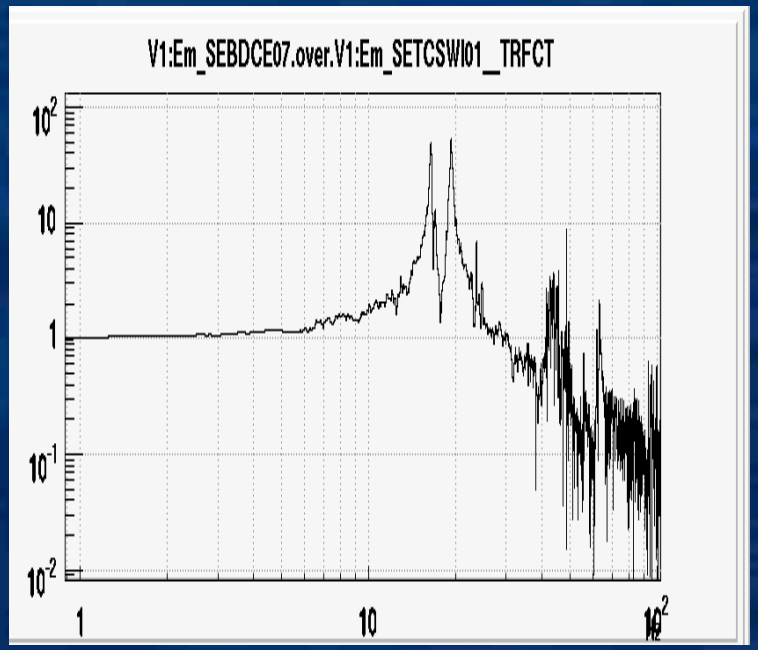
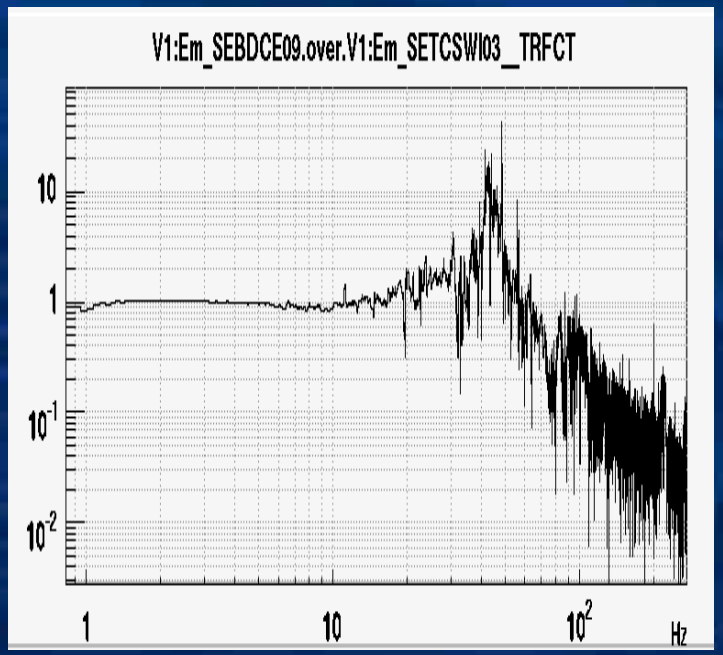
EIB: TF between bench top and ground

Ruggi, eLog 20687

Horizontal, EW
(pendulum modes of bench on legs)



Vertical
(vibration mode of legs top plate)



- amplification of seismic noise by EIB is one of the problems;
- but for V+MS better damping than ground is needed.

Facts (so far)

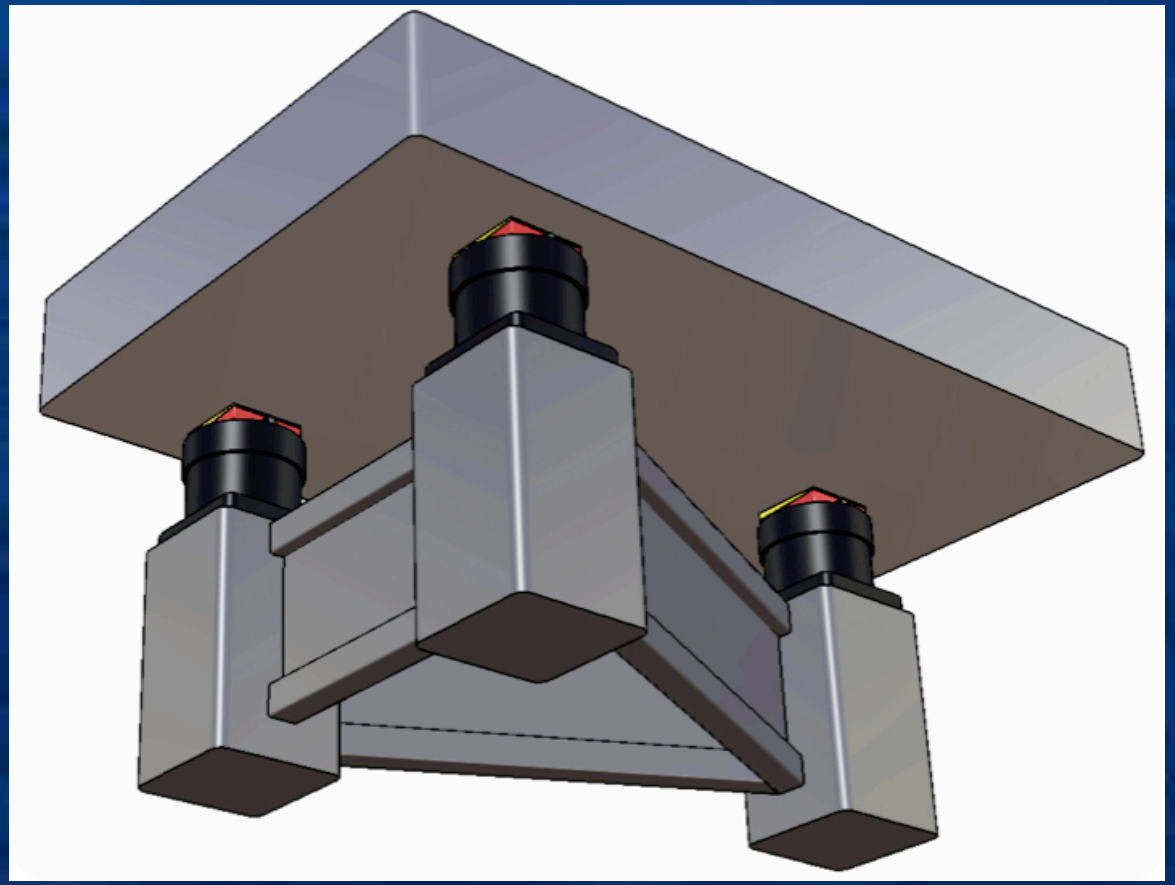
- need factor 100 between 18 and 60 Hz;
- actual legs and EIB *enhance* horizontal movements at ~ 18 Hz (factor ~ 60)
- actual legs and EIB *enhance* vertical movements at ~ 40… 65 Hz (factor ~ 20)

possible solutions (so far)

- supply legs - or support - with more rigidity;
- better vibration cancellation (between support and table top)
  - either active
  - or passive.

more rigid legs

mode	Hz
1	179
2	195
3	198
4	228
5	304
6	318
7	326
8	335
9	352
10	355

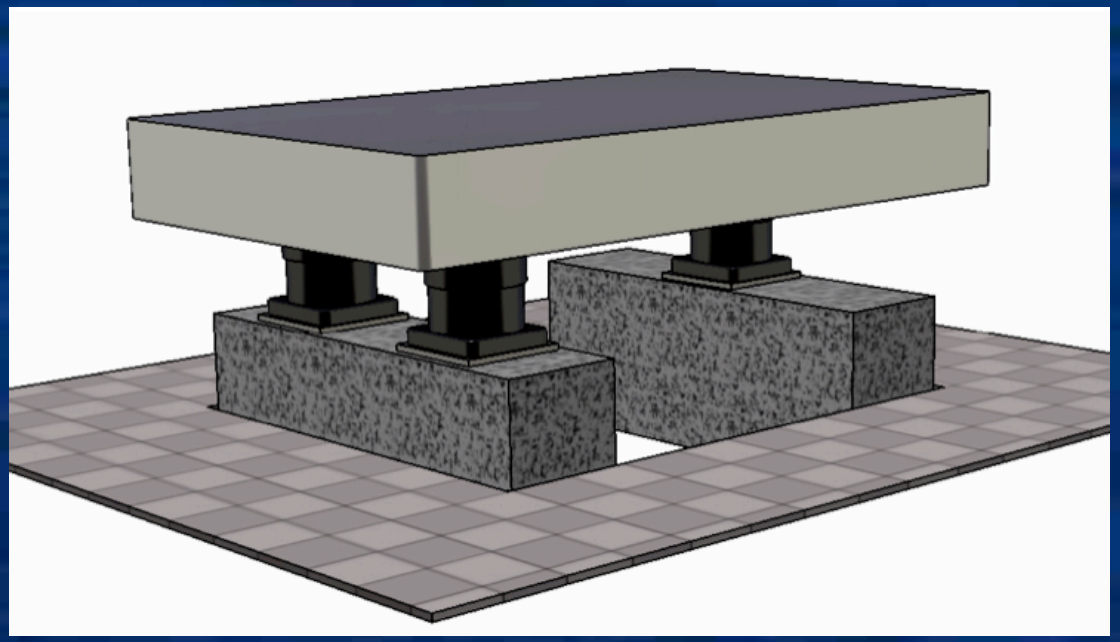


- better legs (the actual ones are not “monolithic”)
- use plates between legs;
- pro: installation underneath EIB simple;
- con: not the most rigid version.

Compliance
$3.93*10^{-6}$ mm/N

more rigid support

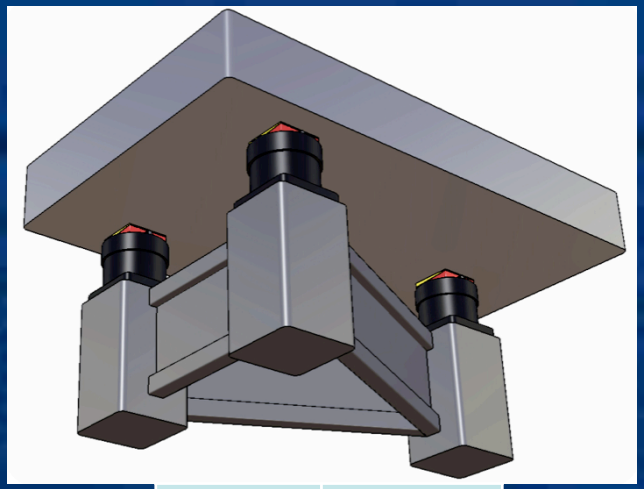
mode	Hz
1	624
2	736
3	963
4	1099
5	1523
6	1678
7	1800
8	1863
9	2022
10	2063



- use granite blocks to raise floor;
- pro: simple, solid solution;
- con: installation less easy.

Compliance
$1.17*10^{-7}$ mm/N

Comparison of support options



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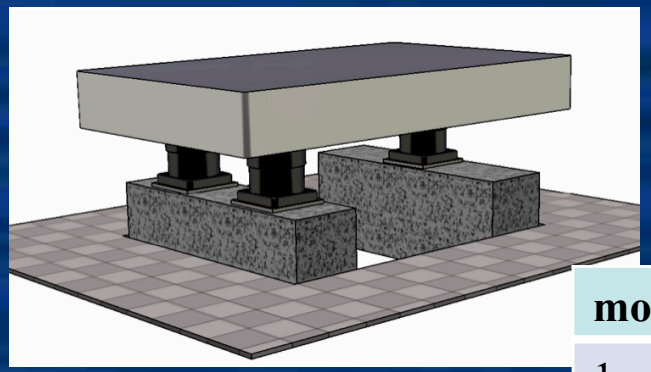

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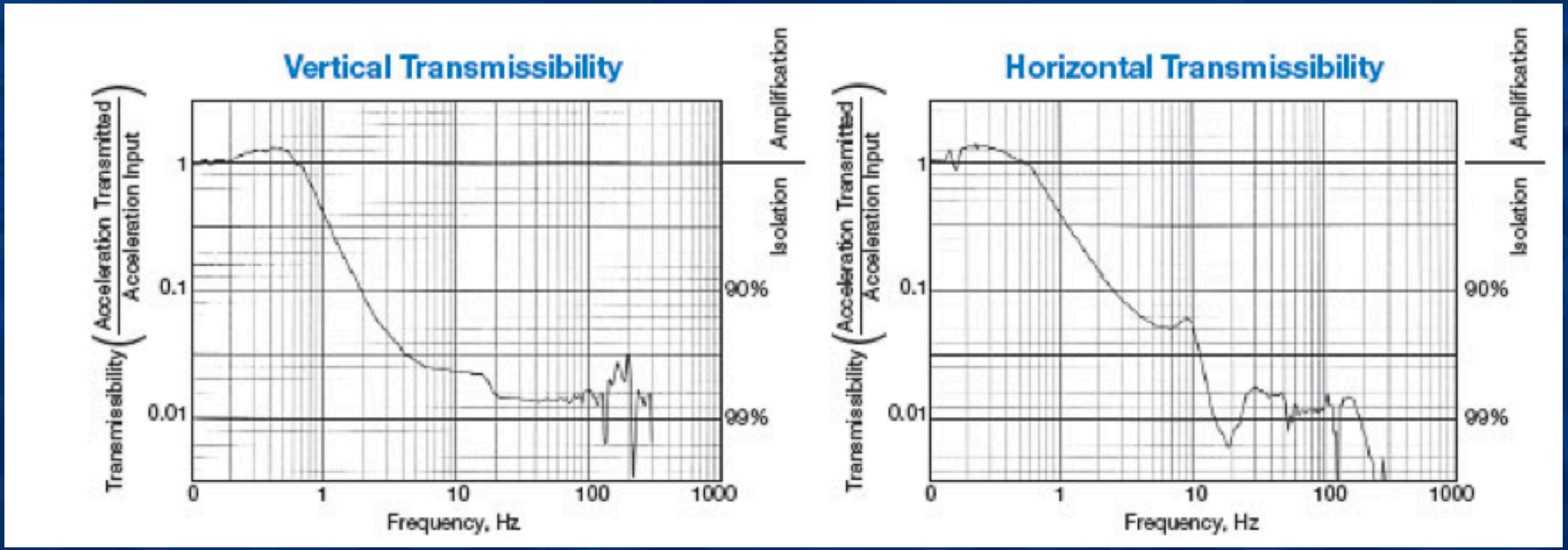
active vibration cancellation

TMC STACIS® Active Piezoelectric Vibration Cancellation System

- need solid support to counteract corrective movements;
- commercial system, matured and proven.

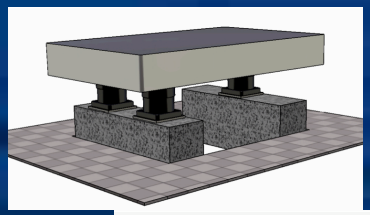
active vibration cancellation

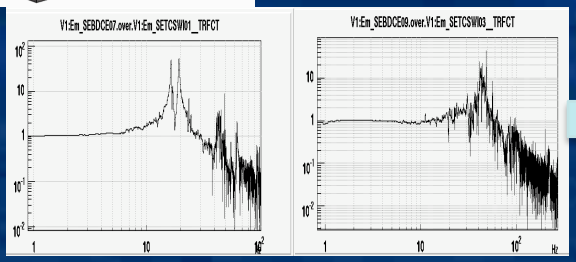
TMC STACIS

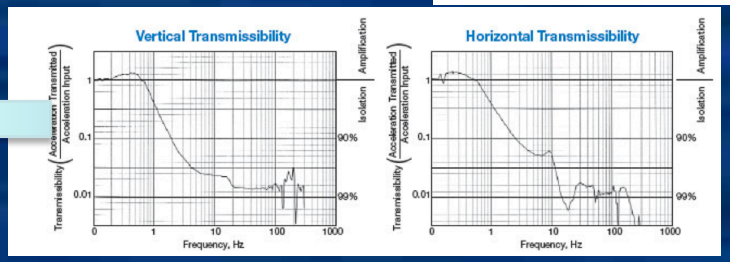


- damping > 50 at f > 10 Hz;
- 6 dof damping;
- 16 external (error/reference) inputs.

achievable mitigation







		gain legs (Fig. 4)	STACIS (*)	achievable damping	needed damping (Fig. 2, 3)
18 Hz	horizontal	55	60	3000	100
45 Hz	vertical	20	60	1200	100

- need: factor ~100;
- support alone good only for factor ~ 20 (vertical; horizontal ~ 60);
- additional damping needed;
- attainable with Stacis : > 1000.

Note: both support types are acceptable for Stacis.

Crimp

from STACIS Installation Manual :

The nominal unloaded height will be decreased by the static deflection and creep in the internal elastomer mount.

The static deflection is approximately 0.14” (3.5 mm) at full load, and the mount will creep.

200 µm in the first 100 hours,
50 µm more after 1,000 to 10,000 hours.

we need to foresee adjusting periods !

Crimp

First 100 hrs: = 4 days : 200 mm
need to realign after one week

Next period 1000 --- 10.000 hrs (~1.5 month to ~ 1.2 year):

- supposedly exponential decay: strong crimp in beginning, less at end.
- can speed up by pre-tension
- 50 μm > retuning ~5 times,
  - external input to STACIS ? – TMC does not like this…
  - Separate system possible
    - but active-on-active system usually is asking for problems
  - can optical alignment of INJ. cope with this?
- over period of 1.5 to 15 months

€ € €

Only price indication, no formal offer;

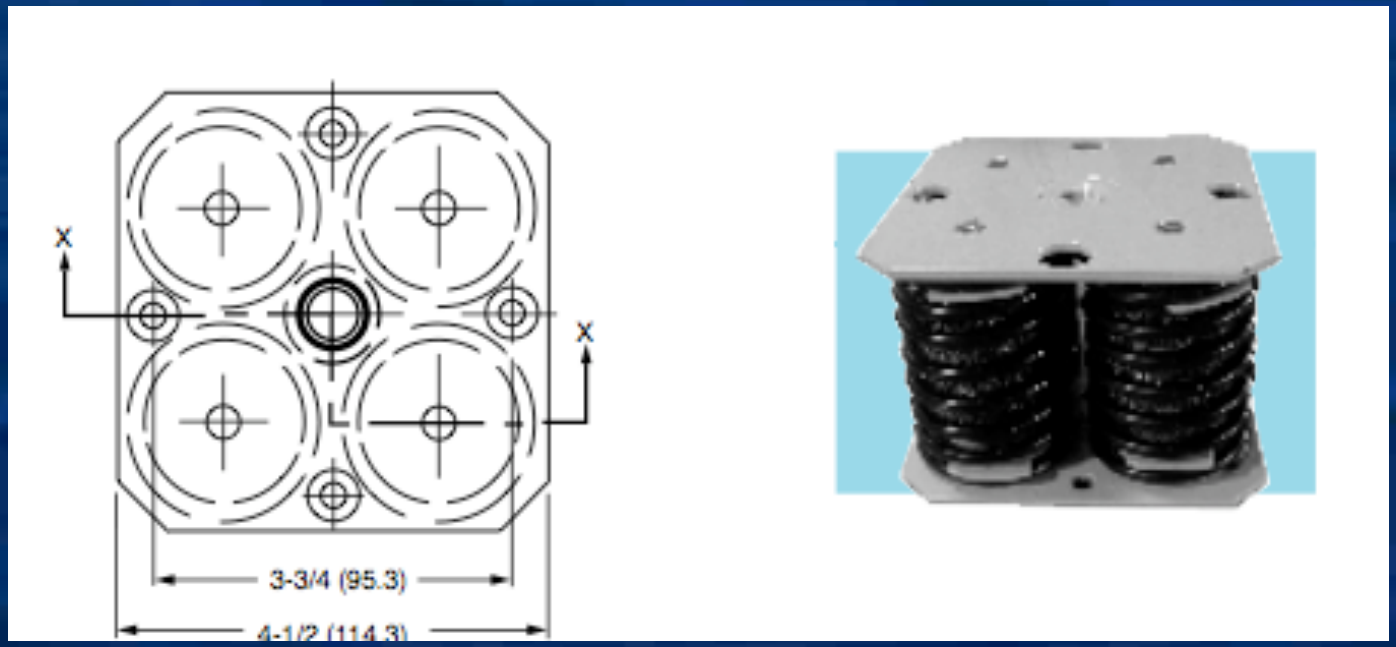
STACIS 3 system:	€ 42 000 ;
4 system:	€ 55 000 ;
Installation:	€ 4 000 ;
Transport:	€ 1 500 ;
Granite (2 blocks)	€ 3 000 ;
“contingency”	€ ……. ;

VAT 20 %

TOTAL ~ € 65 000 (€ 75 000 for 4 Stacis)

Alternative:

Passive vibration cancellation

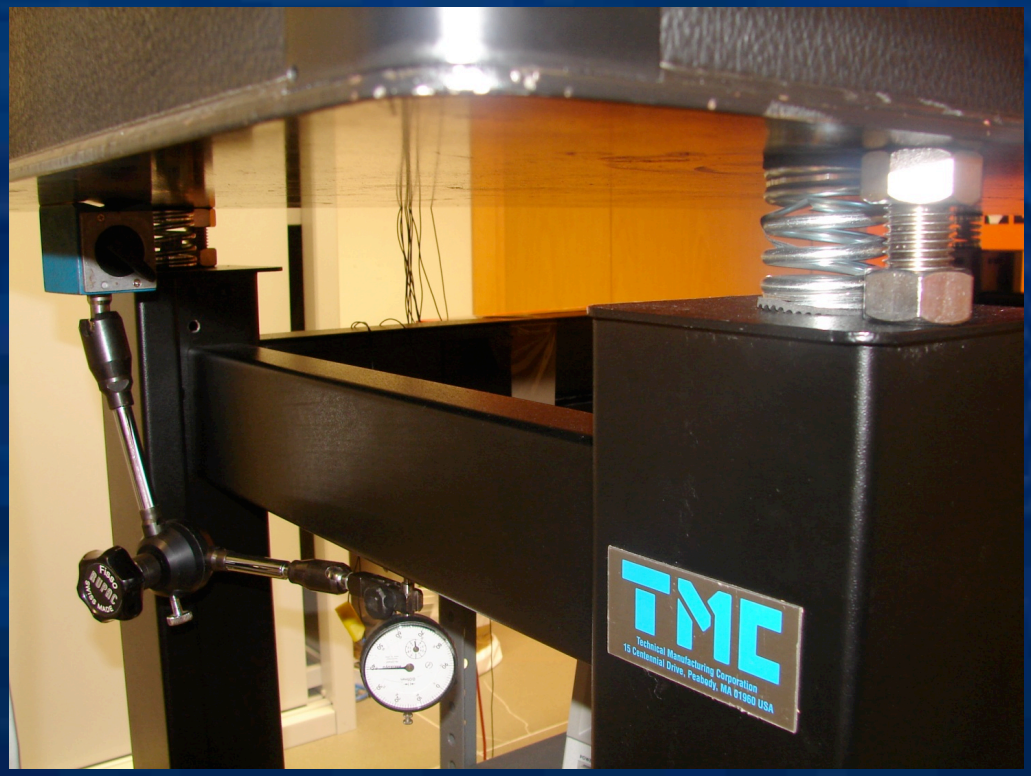


- need solid support to counteract corrective movements;

Springs

*Slide taken from: **I. Fiori**, VIR-0411B-09-1.ppt,*

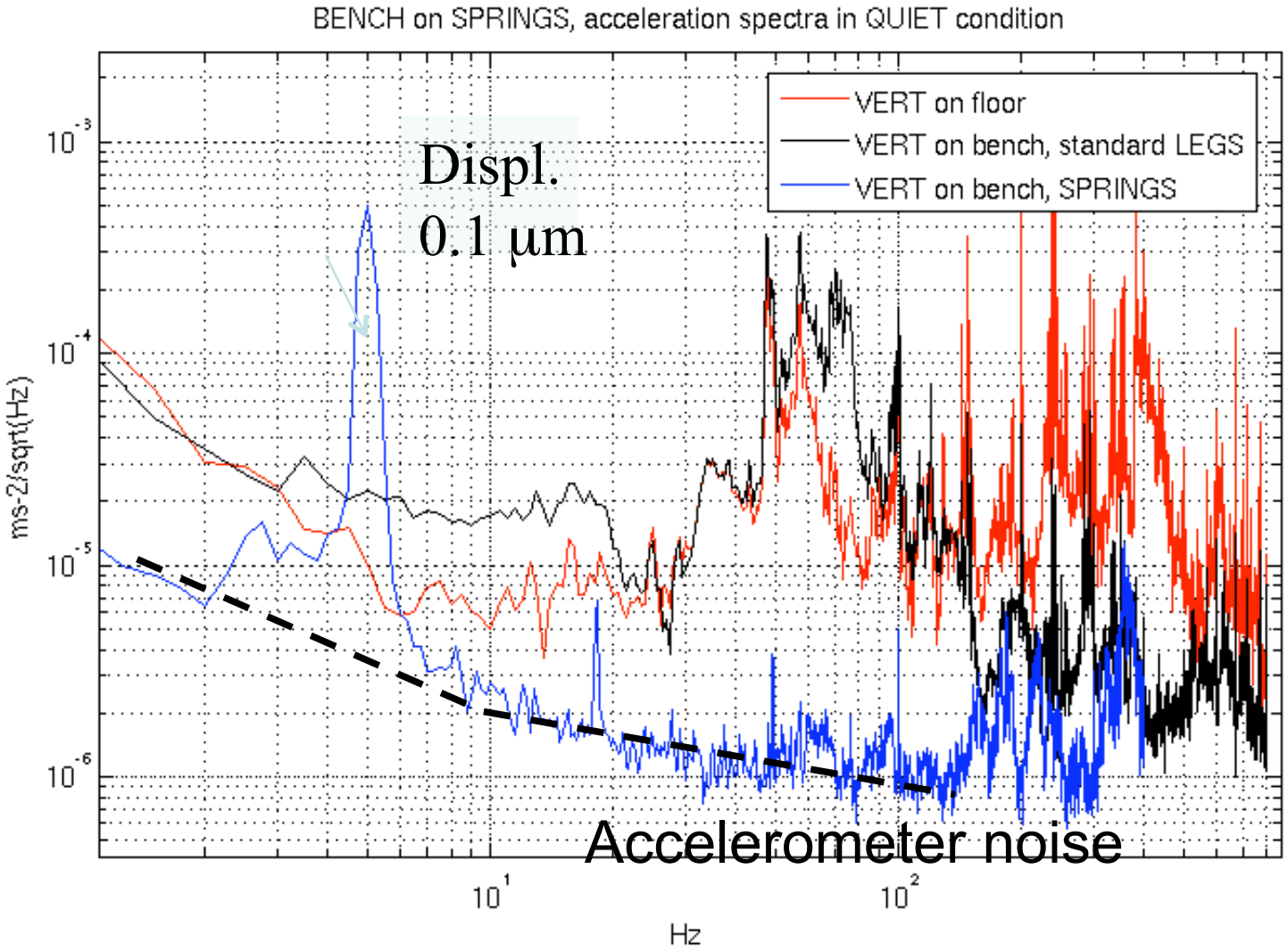
- Spares from AirCond. Mitigation works.
- Nominal frequency: 4-7Hz (vert. and hor.)



Springs

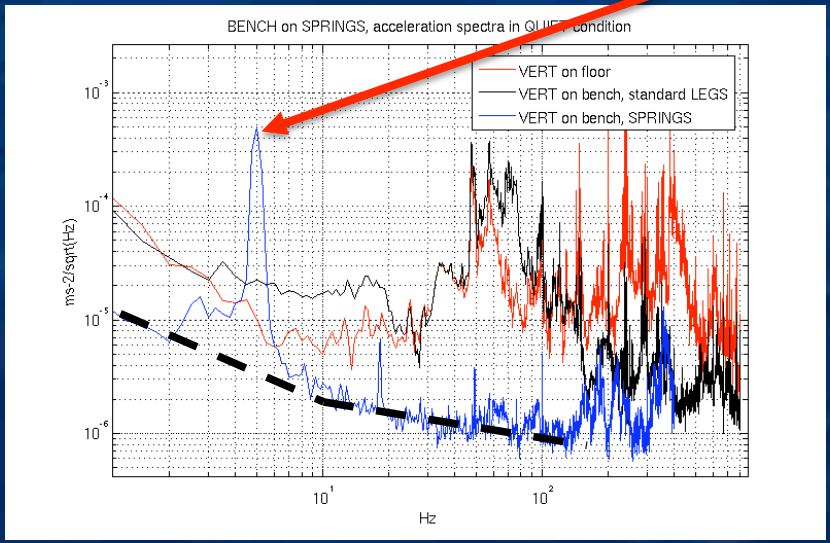
Acceleration FFT

*Slide taken from: **I. Fiori**, VIR-0411B-09-1.ppt,*

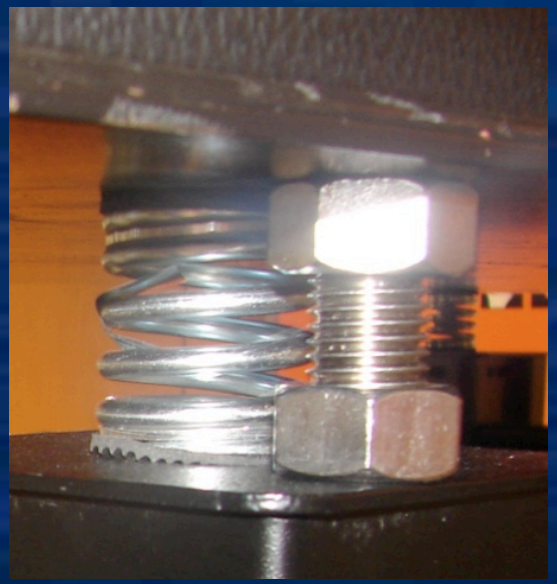


Springs

Acceleration FFT: strong resonance at intrinsic frequency



BUT . . .
this is with a *normal* spring…

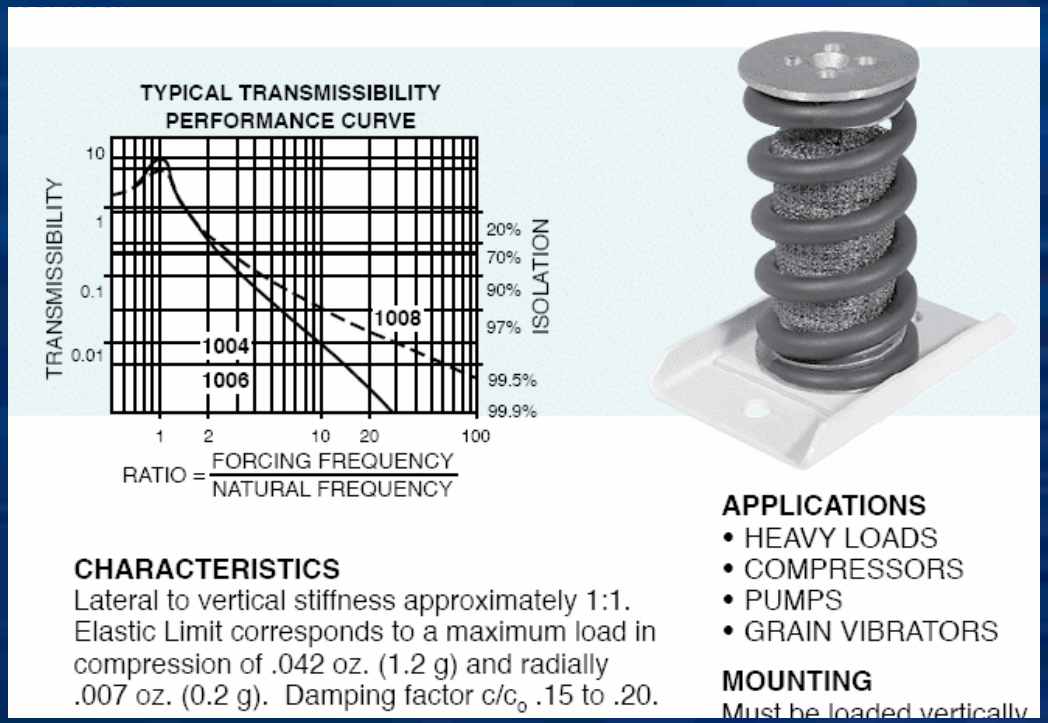


graphics taken from: ***I. Fiori****, VIR-0411B-09-1.ppt,*

Springs

What if one uses ***damped*** springs ?

*graphics taken from: **I. Fiori**, VIR-0411B-09-1.ppt,*



Status

1) Ordered STACIS test setup

2) Ordered damped springs

3) Ordered wedges for vertical adjustment

4) Will have full scale comparison between solutions

5) Decide after tests available

3 … 4 Hz

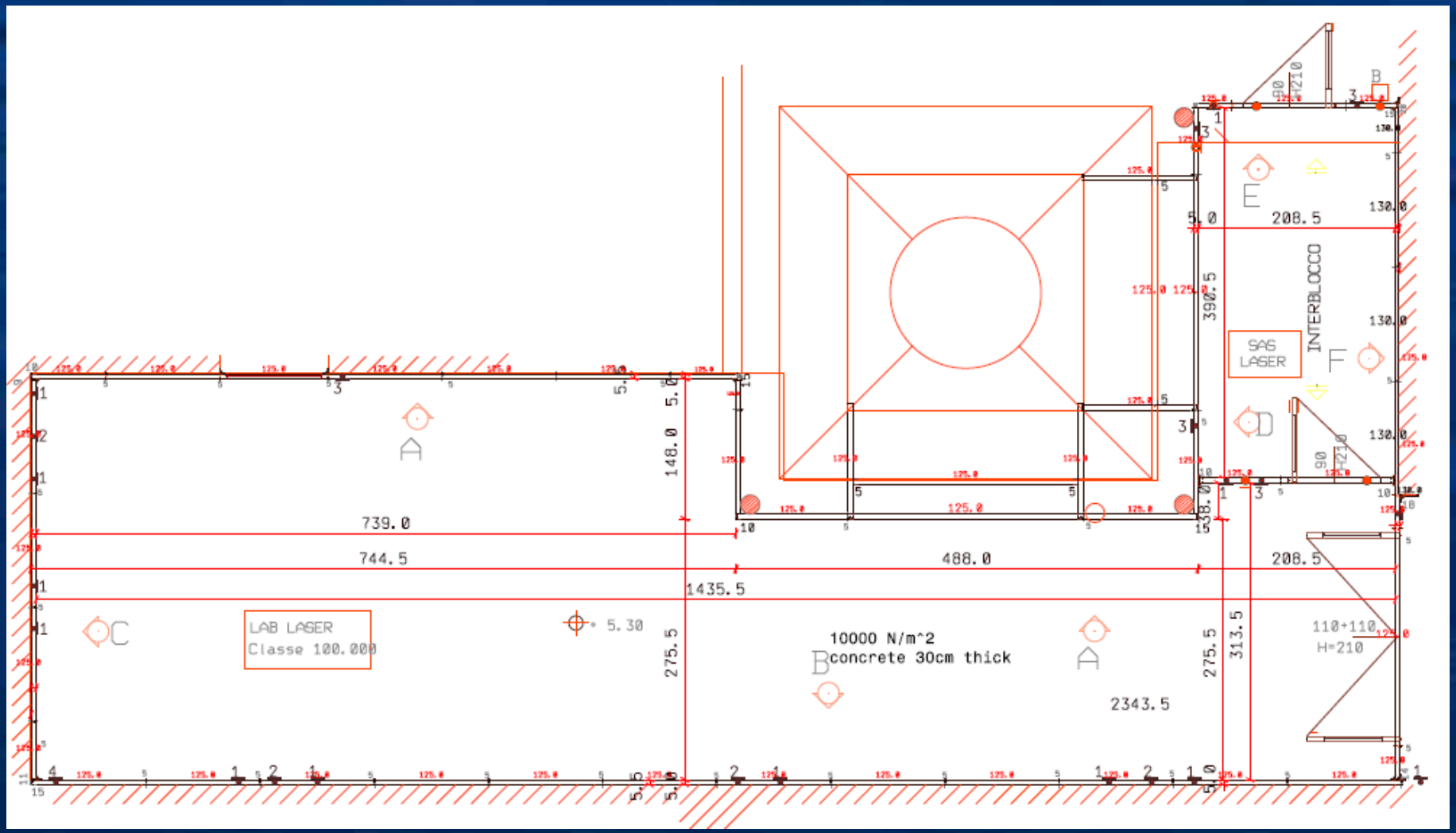
Eigenfrequenz
3–9 Hz

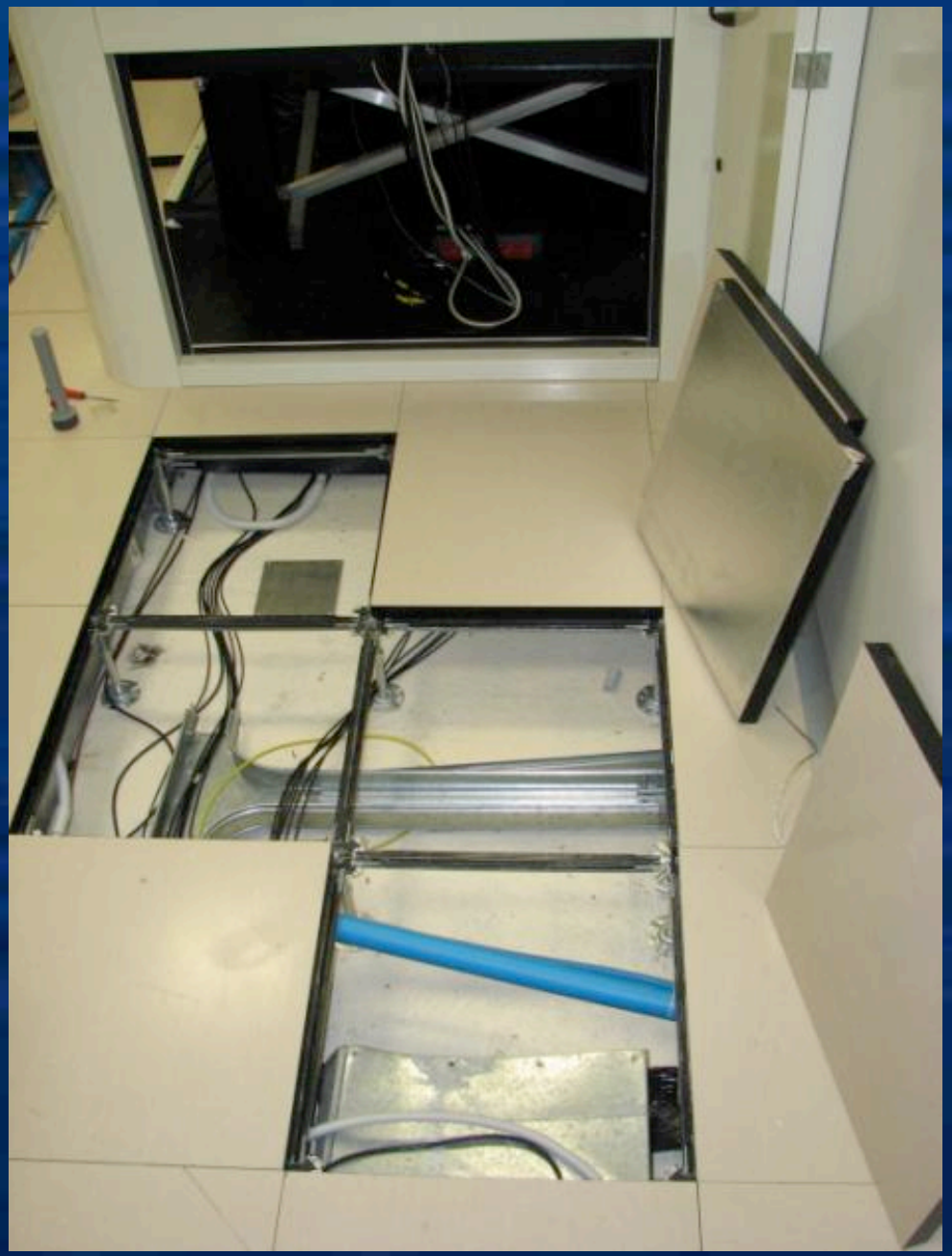
Abbildung: einfache Ausführung mit Grundplatte

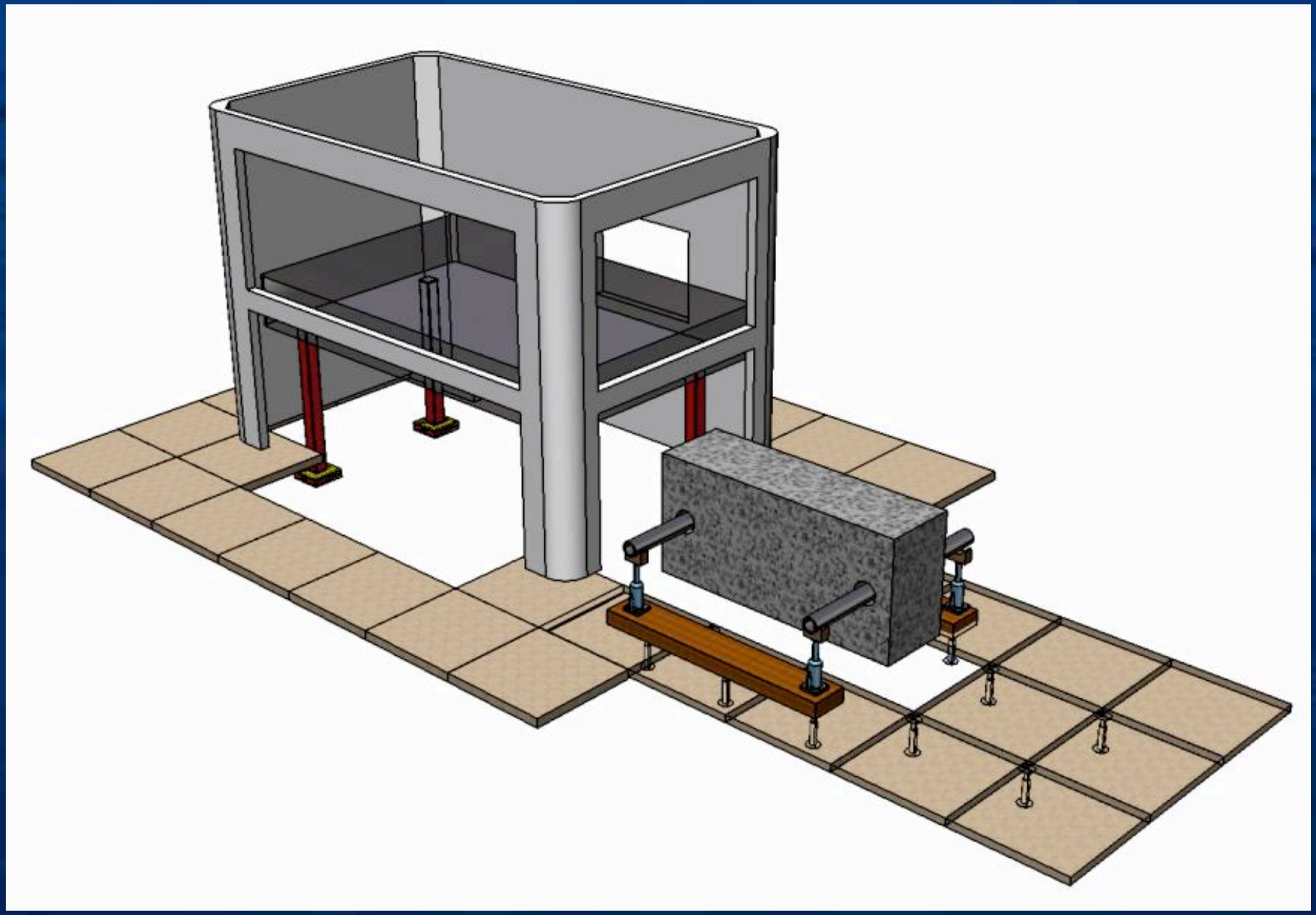
Installation procedure.

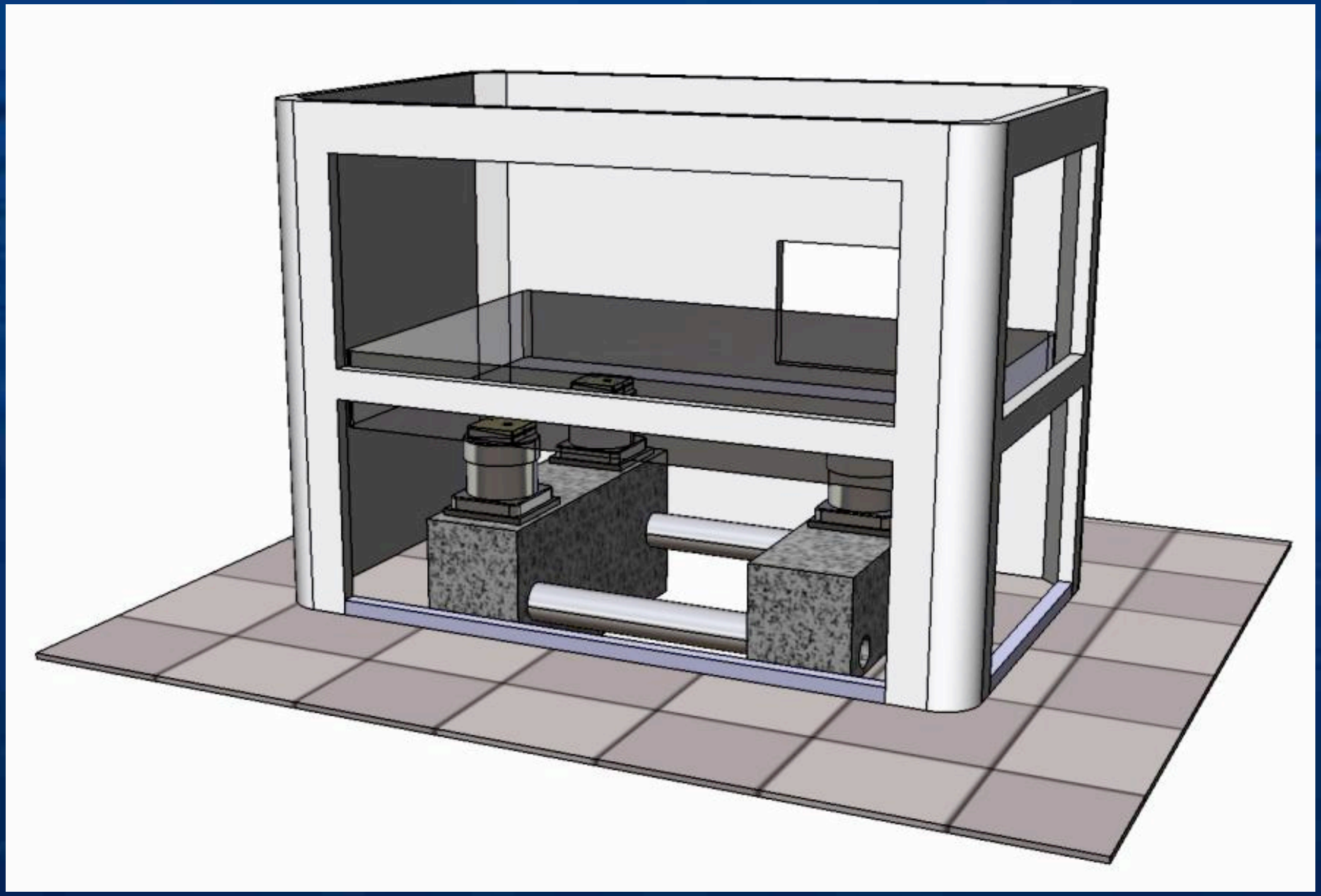
- **Take over current bench position.**
  - use markers and reference points;
  - control with theodolite system;
  - install temporary legs.
- **Protect optic equipment against dust.**
- **Fix cables.**
- **If using granite :** (see the demo).
  - Remove the *raised floor*.
  - Install extra supports under access path.
  - Save the cables under the raised floor.
- **Glue granite on to concrete floor.**
  - With “Sikadur 31 HI-MOD gel” in a frame work.

The laser lab (EIB location)









Summary

- **Seismic damping of EIB must be improved by factor ~ 100;**
- **better support than actual legs will improve situation;**
- **but still better damping needed;**

- **STACIS 2100 (by TCM) can provide this additional damping.**
- **alternative: damped springs with low eigenfrequency (~ 3 Hz)**

- **Support can be either**
  - **metallic Tripod** (easier to install)
  - **Granite blocks** (much better performance). ← preference!

- **Creep can be a problem in beginning.**

- **Plans:**

  - **build a test case at Nikhef, for both STACIS and Springs;**
  - **if OK, install in January 2010 at Virgo EIB.**

The End.