Vibration effects induced by cooling and ventilation of the CLIC module

Mechanical Measurement Lab, EN/MME
L. Lacny, L. Scislo M. Guinchard

Small additions by A. Vamvakas

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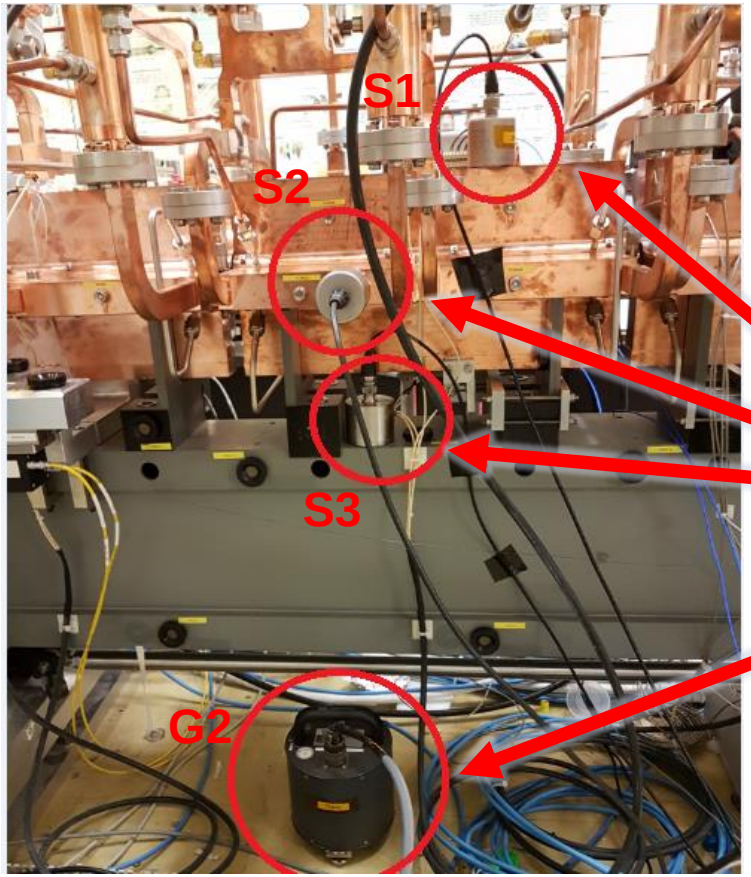
Presentation outline

- Measurement setup / equipment
- CLIC Measurement schedule
- Ground vibration
- CLIC Module vibration
  - All subsystems OFF vs ON
  - Separate systems ON
- Integrated RMS of vibration

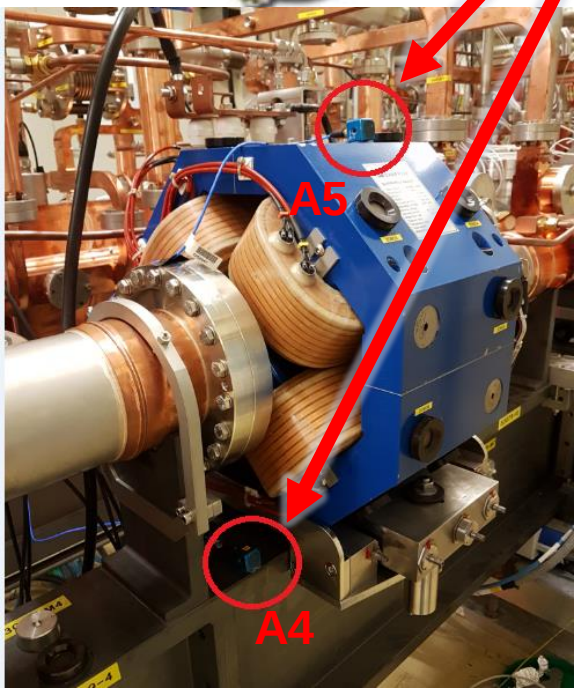
CLIC Measurement setup

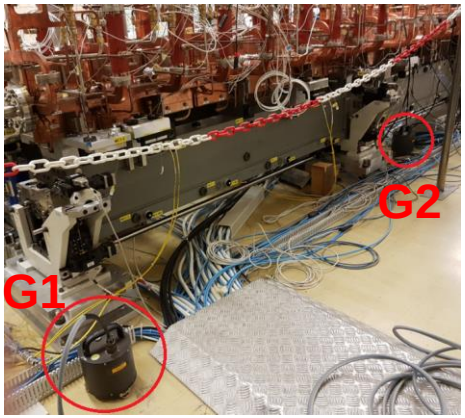


3 X SEISMIC

2 x GEOPHONE

2 x 3-AXIAL ACC





Vibration effects induced by cooling and ventilation of the CLIC module

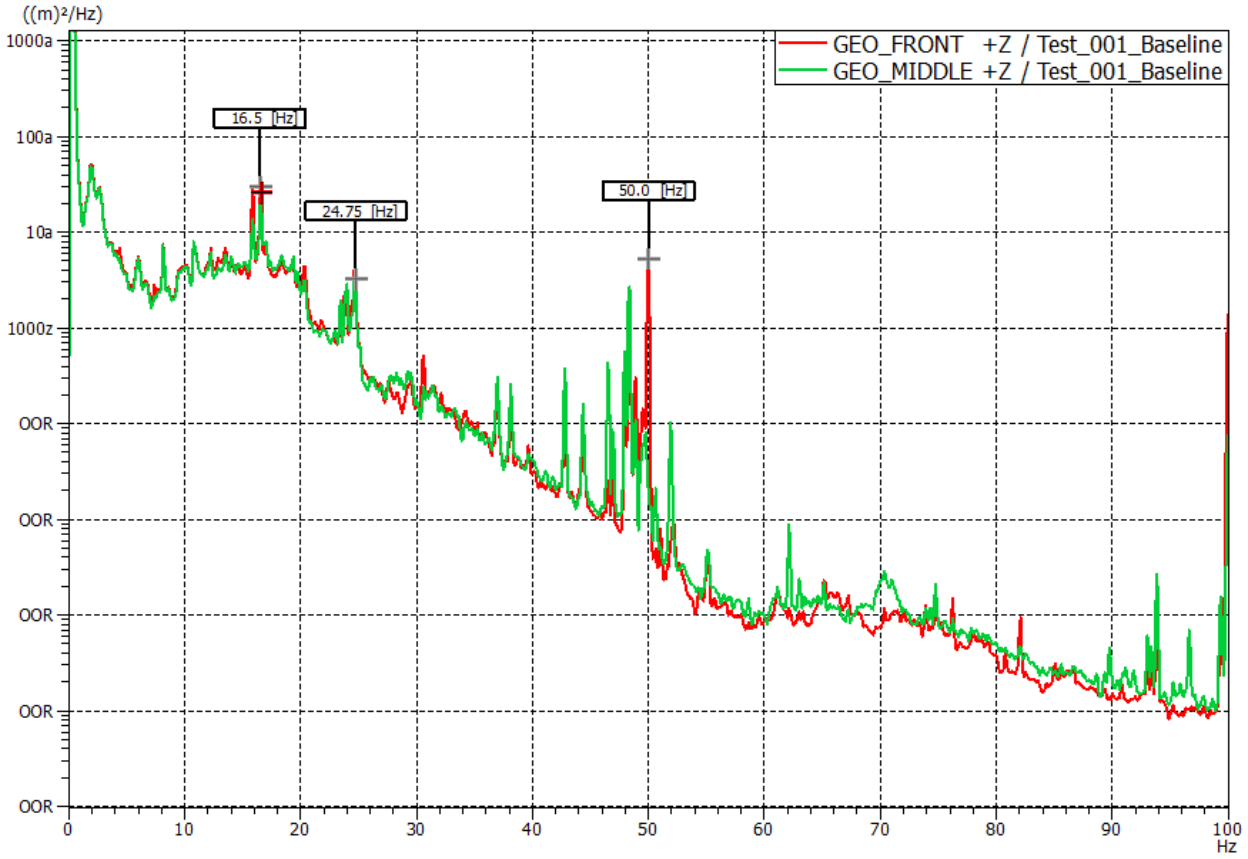
Time	VENTILATION	WATER
Tue 10:50-11:00	OFF	OFF
Tue 11:10-11:20	ON (50%)	OFF
Tue 11:50-12:00	OFF	ON (50%)
Tue 12:05-12:15	OFF	ON (100%)
Tue 12:20-12:30	ON (100%)	ON (100%)
Tue 13:55-14:05	ON (100%)	OFF

ventilation	50%	100%
Air speed	0.4 m/s	1.3 m/s
Fan control frequency	20 Hz	45 Hz

Water	50%	100%
SAS flow	1 lt/min	2 lt/min

Ground vibration (all systems off)

DATE & TIME	VENTILATION	WATER
2018/02/20 10h50	OFF	OFF



PSD

Power Spectral Density

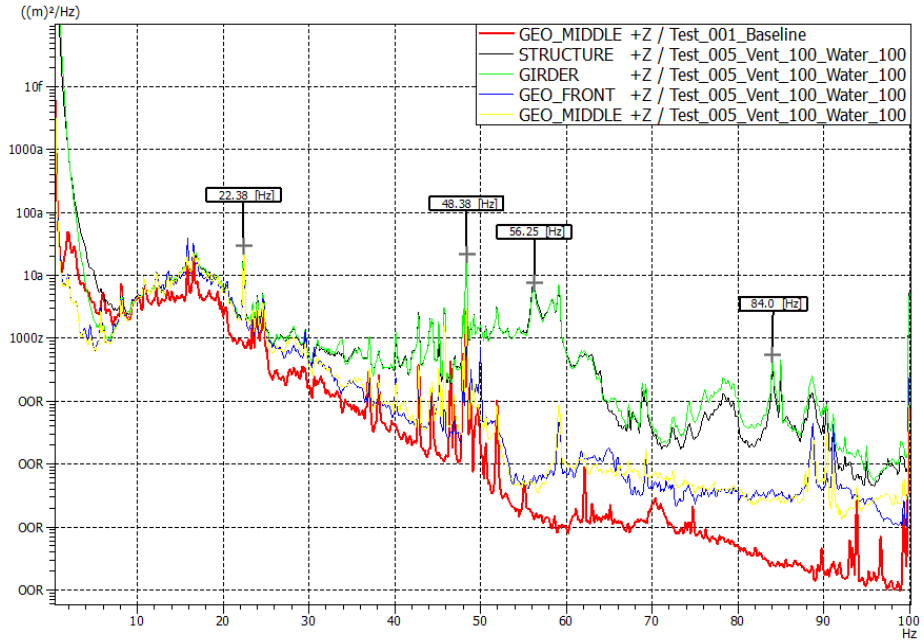
$$\phi_{ww} = \frac{\left(\overline{S_w^2}\right)}{fr}$$

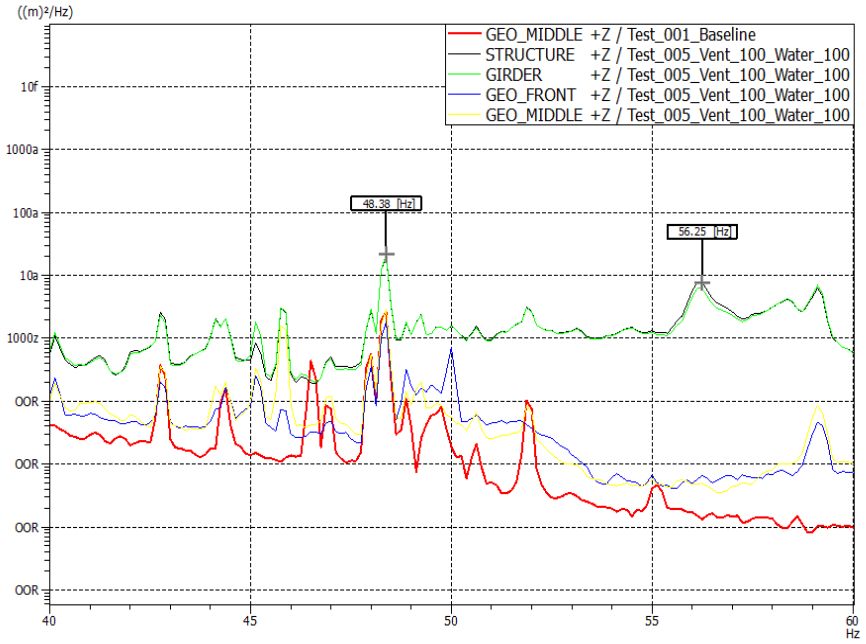
$\overline{S_w}$: average magnitude of FFT spectrum [rms]

fr: *Frequency resolution*

CLIC Module Vibration (ALL modules OFF vs ALL ON)

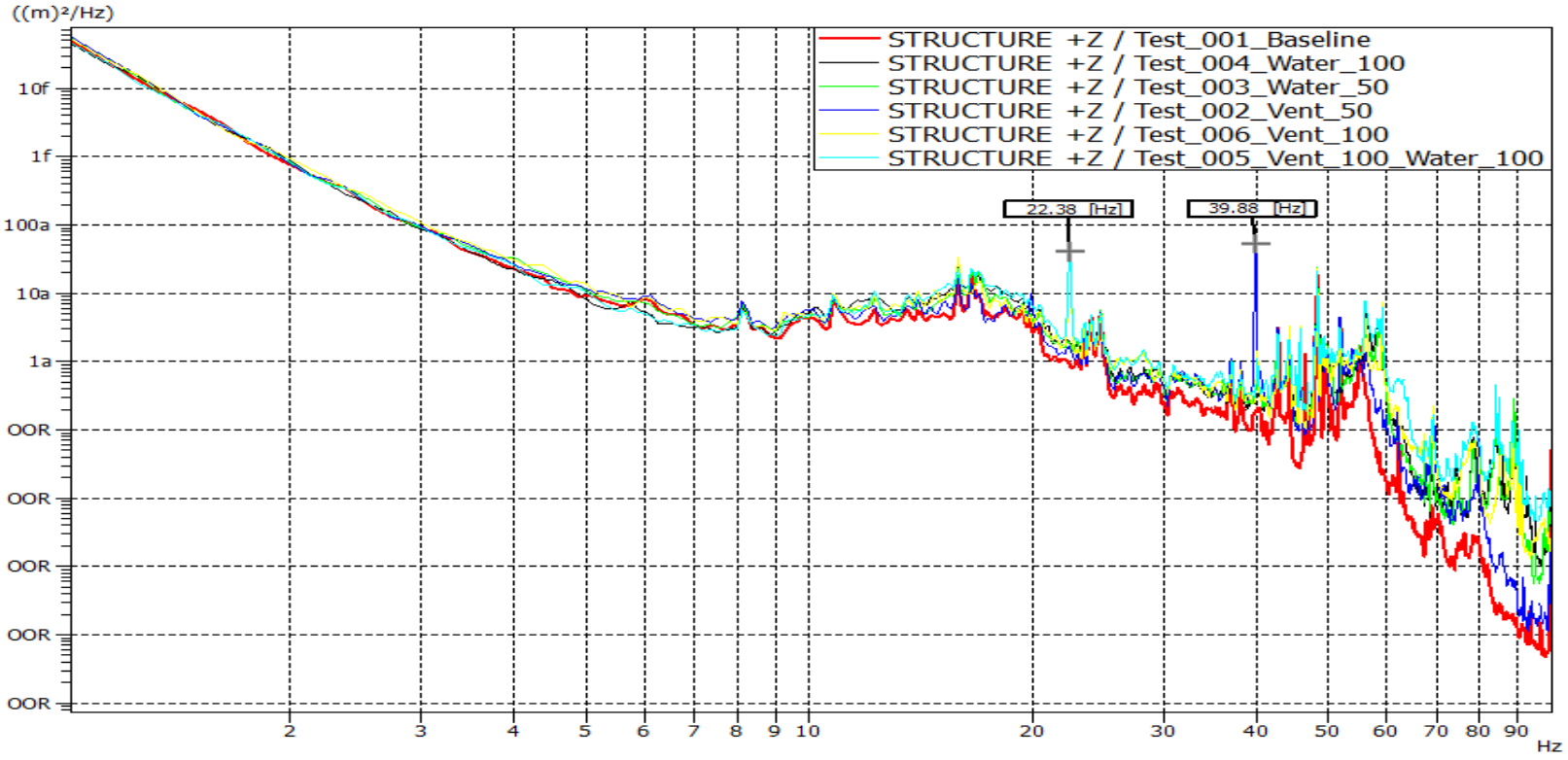
DATE & TIME	VENTILATION	WATER
2018/02/20 12h20	ON	ON
2018/02/20 10h50	OFF	OFF





CLIC Module Vibration (separate systems ON vs OFF)- test position on the structure

DATE & TIME	VENTILATION	WATER
2018/02/20 11h20	ON (50%)	OFF
2018/02/20 11h50	OFF	ON (50%)
2018/02/20 12h05	OFF	ON (100%)
2018/02/20 13h55	ON (100%)	OFF
2018/02/20 13h55	ON (100%)	ON (100%)



CLIC Module Vibration (separate systems ON vs OFF)- test position on the structure

DATE & TIME	VENTILATION	WATER
2018/02/20 11h20	ON (50%)	OFF
2018/02/20 11h50	OFF	ON (50%)
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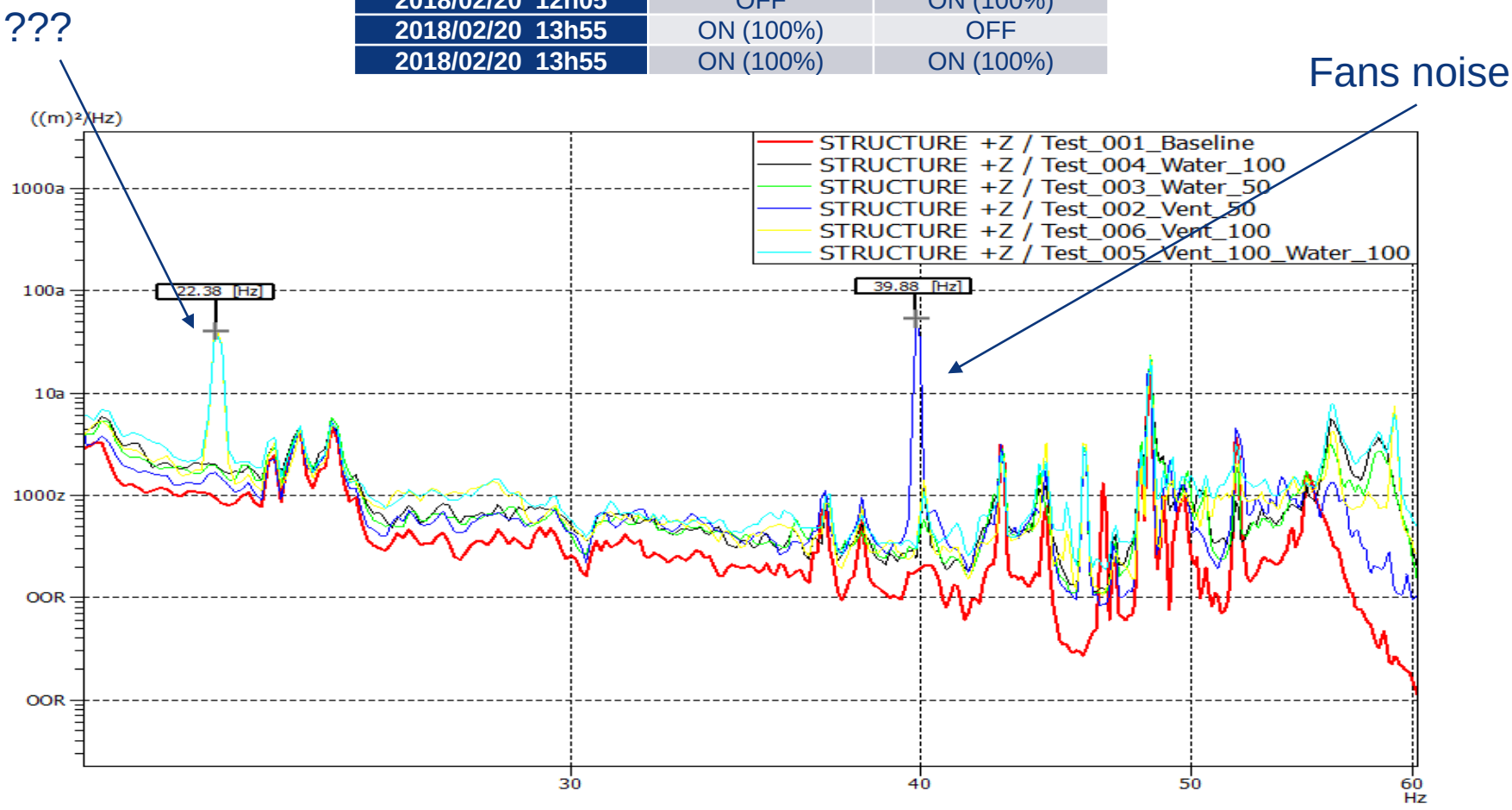
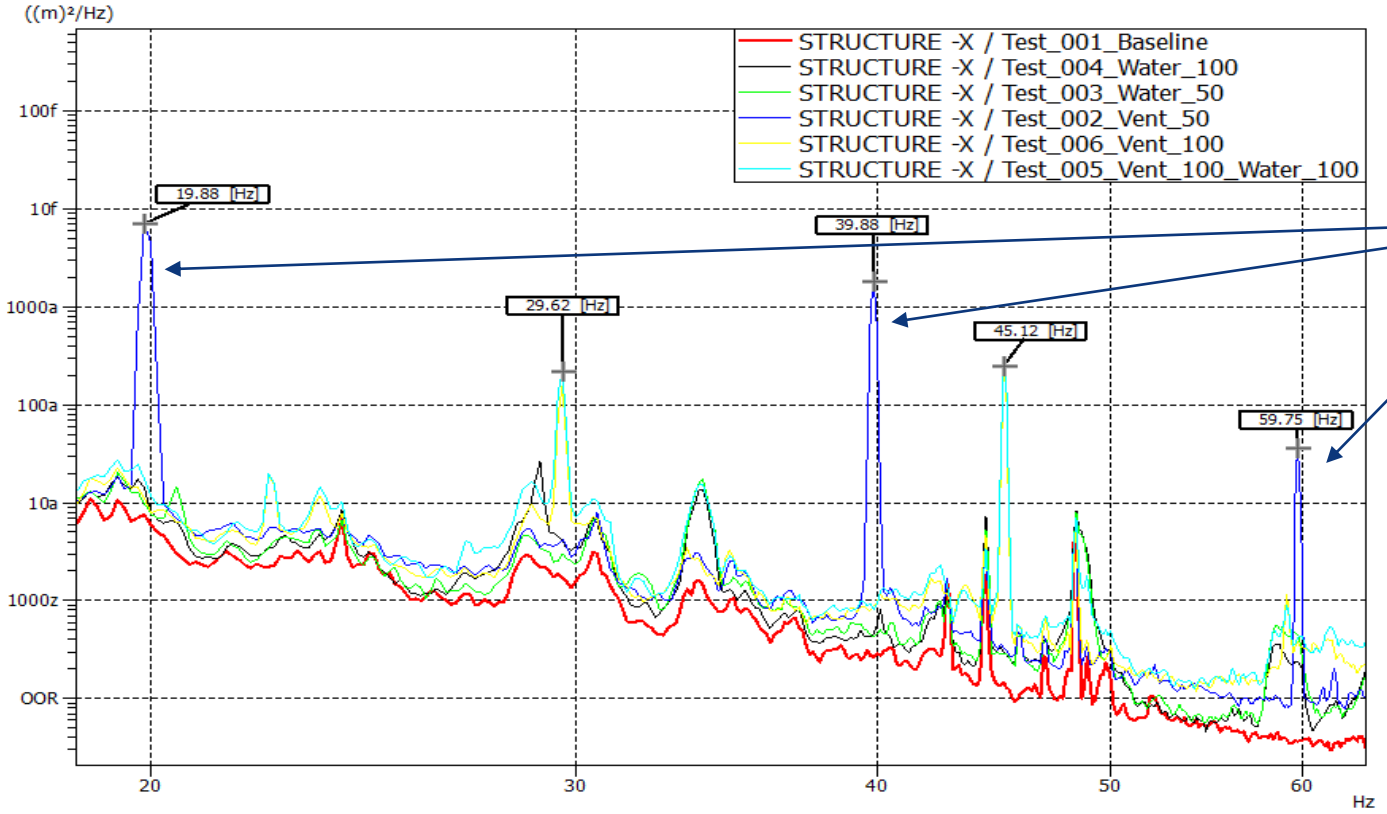
2018/02/20 13h55	ON (100%)	OFF
2018/02/20 13h55	ON (100%)	ON (100%)



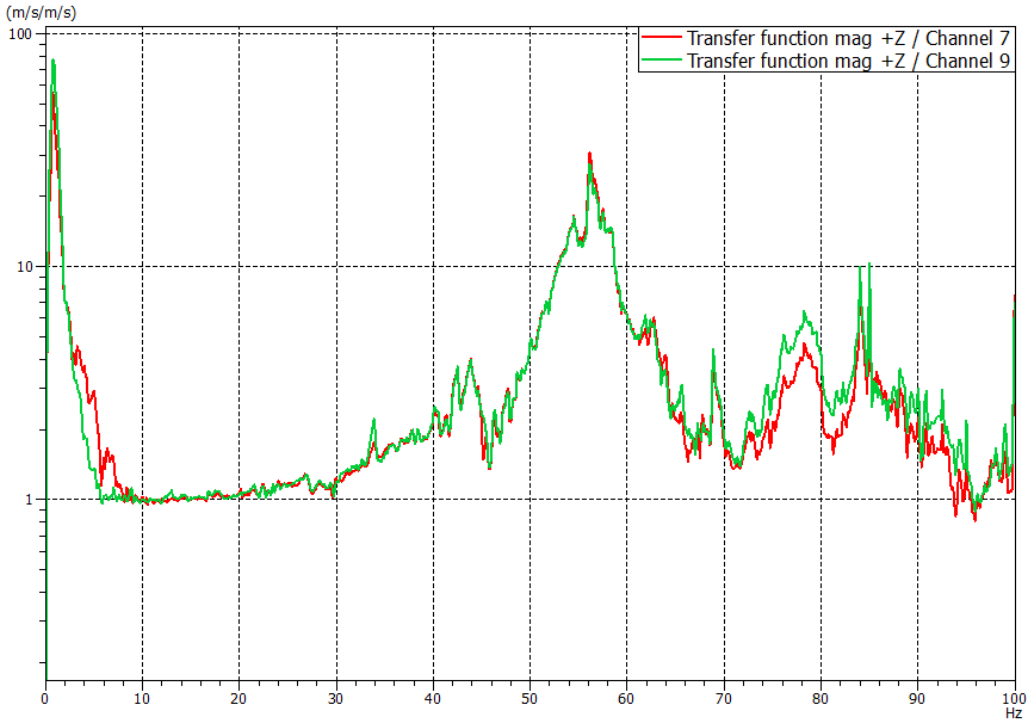
CLIC Module Vibration (separate systems ON vs OFF)- test position on the structure

DATE & TIME	VENTILATION	WATER
2018/02/20 11h20	ON (50%)	OFF
2018/02/20 11h50	OFF	ON (50%)
2018/02/20 12h05	OFF	ON (100%)
2018/02/20 13h55	ON (100%)	OFF
2018/02/20 13h55	ON (100%)	ON (100%)



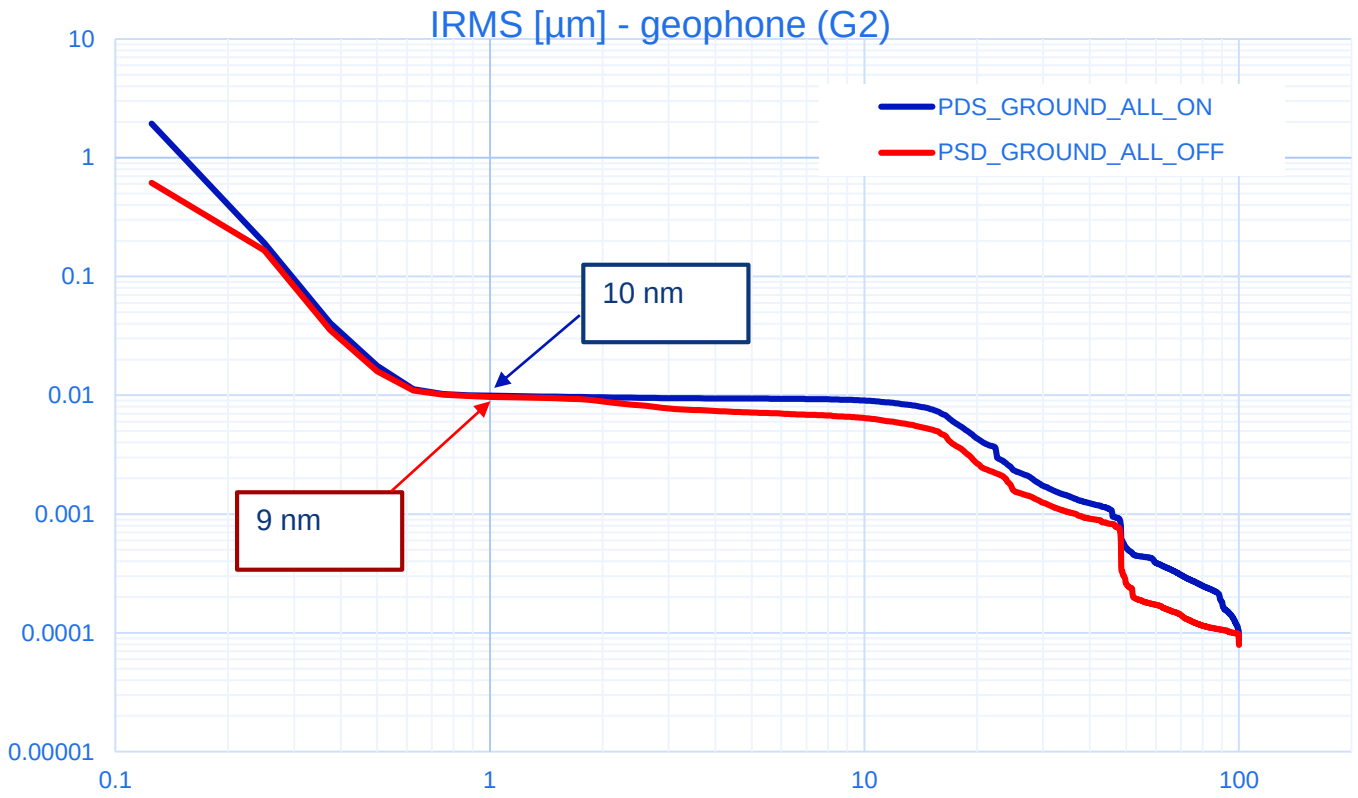
Fans noise

Transfer function - vertical



- Ground to Girder transfer
- Ground to SAS transfer
- Similar behavior of the two

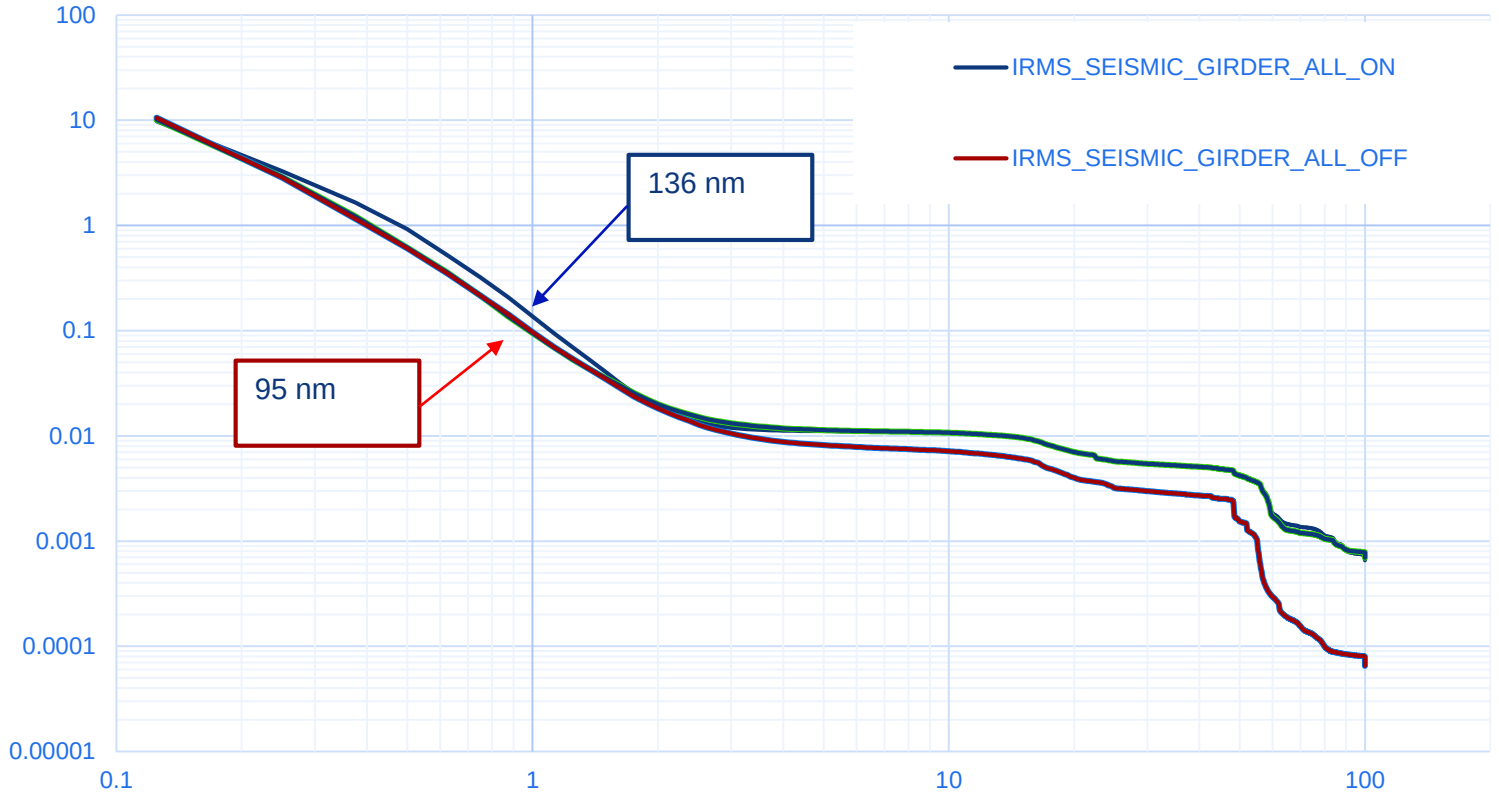
Ground vibration – IRMS [µm]



$$\sigma_w(f) = \sqrt{\int_{f=100Hz}^{f=fr} \phi_w(f)df}$$

Girder vibration – IRMS [µm]

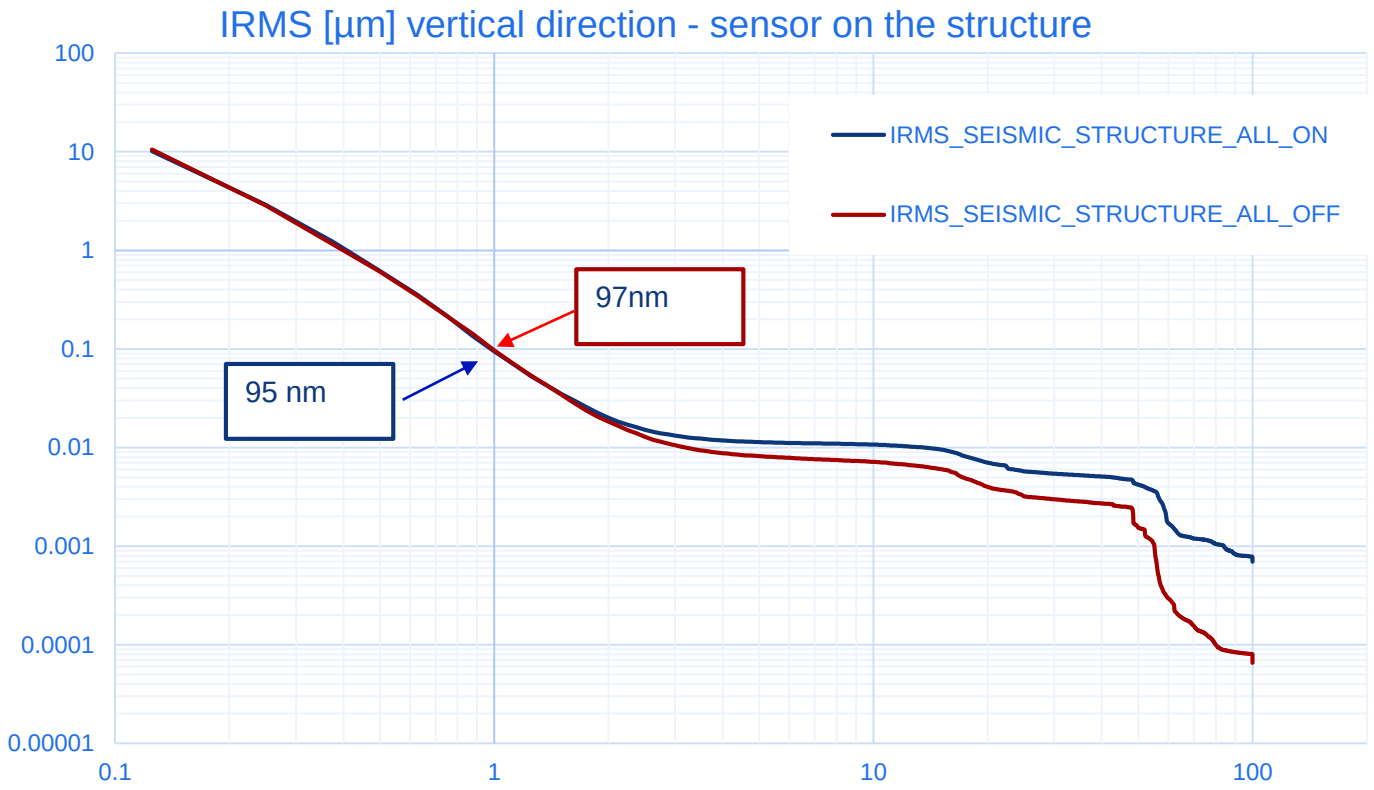
IRMS [µm] vertical direction - sensor on the girder



$$\sigma_w(f) = \sqrt{\int_{f=100Hz}^{f=fr} \phi_w(f)df}$$

Frequency [Hz]

SAS vibration – IRMS [µm]



$$\sigma_w(f) = \sqrt{\int_{f=100Hz}^{f=fr} \phi_w(f)df}$$

Conclusions

- Overall vibrations are relatively low
- Water does not seem to have a big effect
- Ventilation excites certain frequencies, but might be due to the fan noise
- Waiting for the DBQ measurements, error level expected to be higher

- Full report: EDMS 1808081