Determining rock quantities using swathe techniques on Maasvlakte 2

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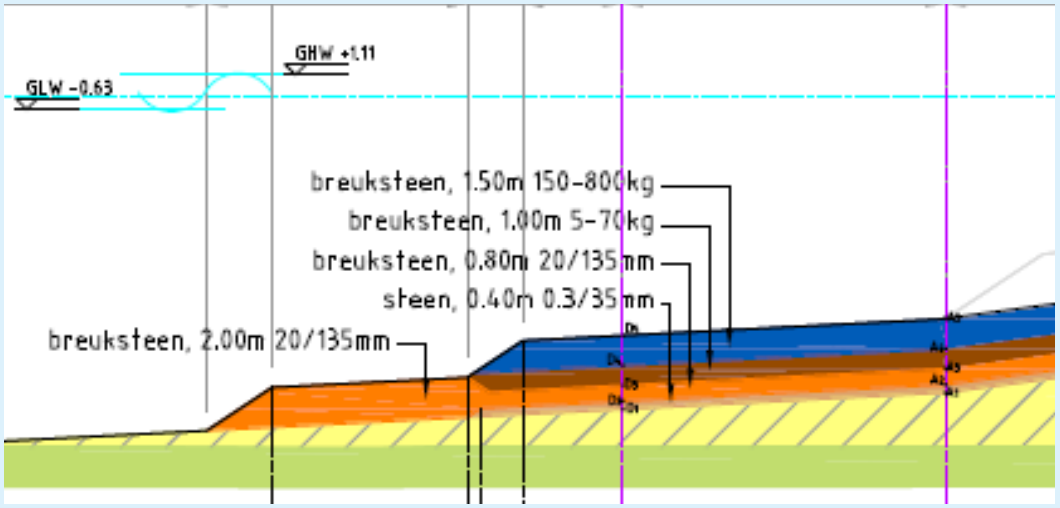
Maasvlakte 2 Port extension

- Largest works in Western Europe
  - Design and construct
  - Contractor (PUMA) responsible for surveys
- Stone sea defence
  - Different gradations
  - ‘Critical’ design in terms of layer thickness



Survey ‘challenges’

- Design criteria pre-defined; survey system to be selected
- Layer thickness = out-survey – in-survey
- Unknown factors
  - Design reference: ‘top of stones’
  - Rock manual: semi-spherical foot staff in 1x1 m
  - Verolme Dock trials (1999)
    - Multibeam lower than semi-spherical foot staff
    - Limited tests (10/60 + 40/200 kg)
    - ‘Older’ type multibeam systems
- High accuracy required due to small layer thickness

Research questions

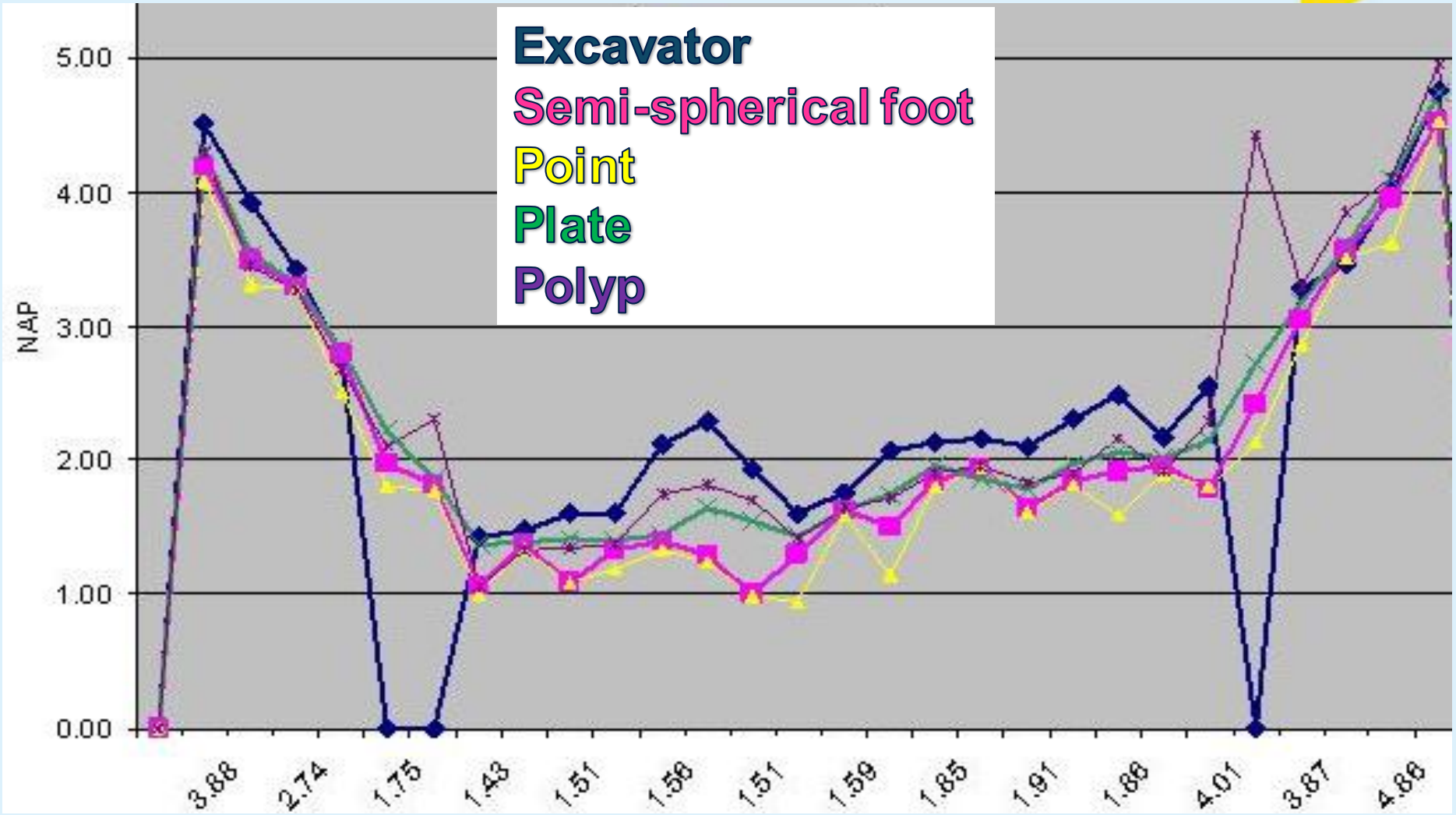
- How do current survey systems interact with stone layers?
- What is the relation between the survey results and the reference level?
  - What are the differences?
  - Can corrections be applied?
  - Is there a general rule?

Methodology

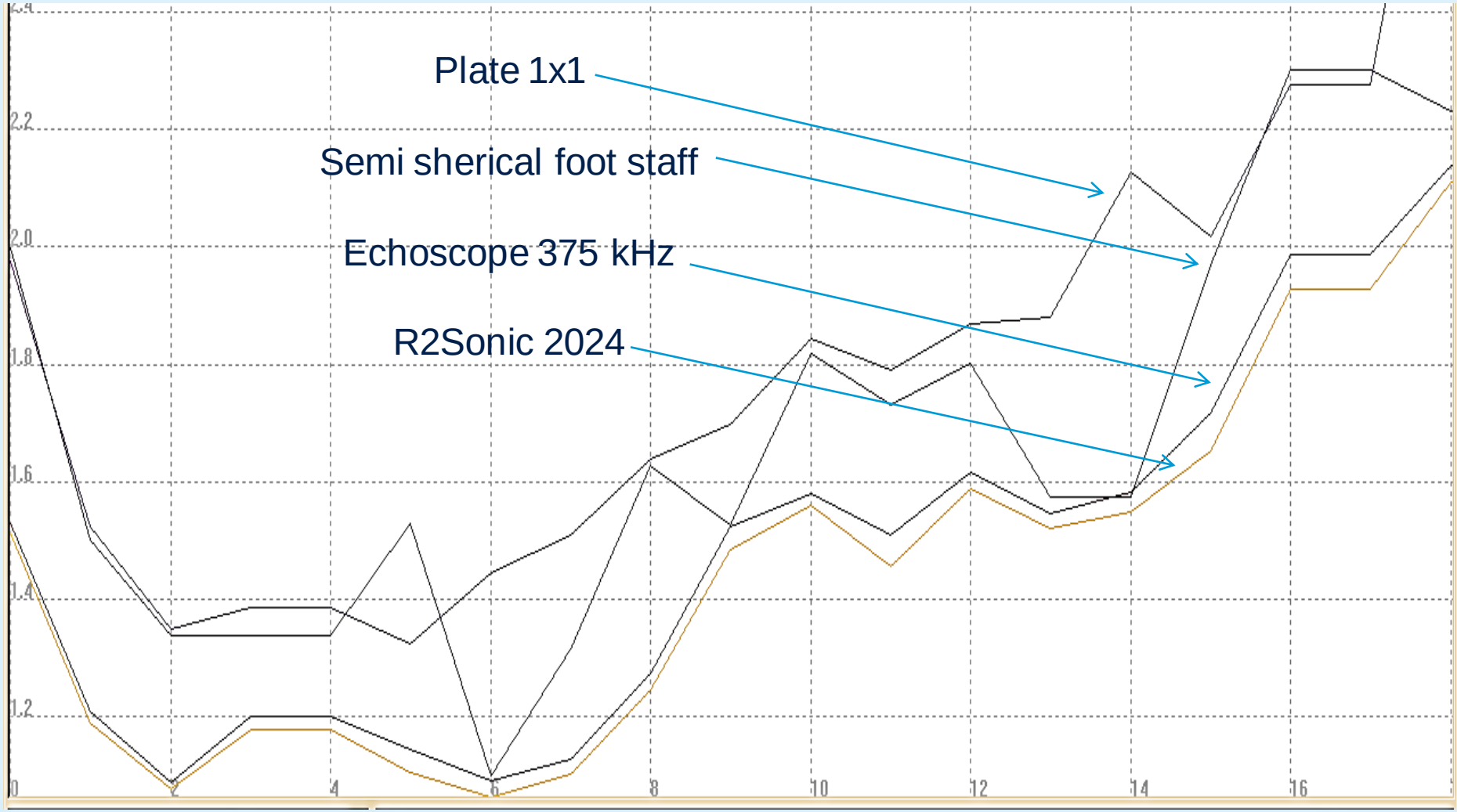
- MV2 test-pit: a controlled environment
  - Construct dry, measure dry & wet
  - All MV2 gradations / slope types
- (potential) Survey systems to be used for works:
  - Point measurements (1x1 meter grid):
    - Semi-spherical foot staff, plate and point
    - Crane fixes with buckets (5), polyps (2) and grab (1)
  - Survey lines: Singlebeam echosounder (2)
  - Swathe (full coverage):
    - Multibeam systems (7)
    - Laser systems (4)

Overview of measurements

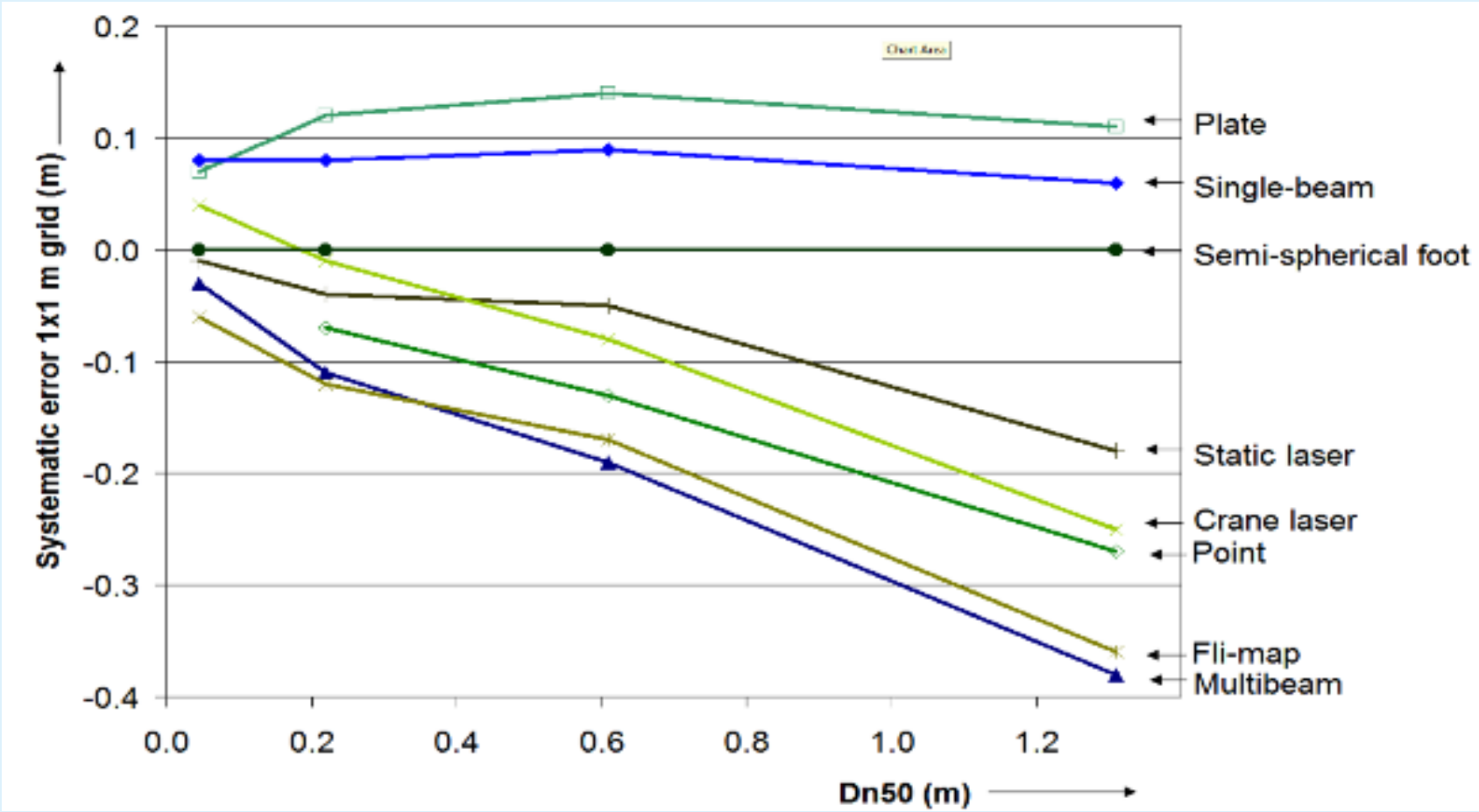
Differences in ‘dry’ measurements 150 – 800 kg



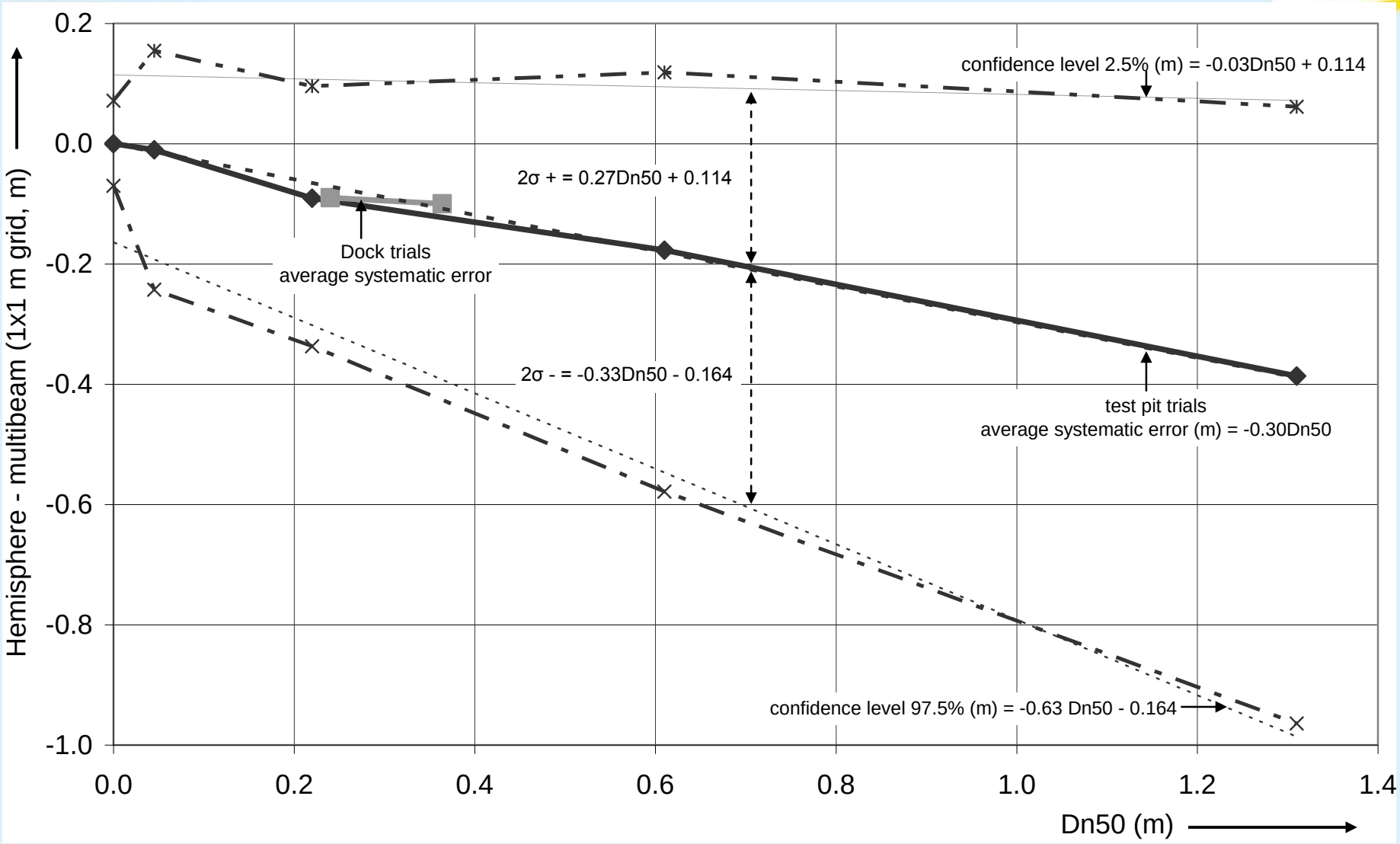
Differences in ‘wet’ measurements 150 – 800 kg



Results: average differences reference = semi-spherical foot



Results: multibeam in detail



Discussion

- Stone surveys need to be corrected to indicate ‘true’ levels
- General laws seem to apply
- Systematic difference (average over large surface)
  - Difference between survey & reference: approx 0.3 Dn50 (MBES)
  - Risk for average layer thickness
- Precision of survey (2SD, variation in 1x1 m grid) due to:
  - Survey (in)accuracy: approx 0.06 m (MBES)
  - Gradation / Dn50: approx 0.3 Dn50 (MBES)
  - Risk for minimum layer thickness
  - Risk for minimum depth over construction

Conclusions

- Results from test-pit & 1999 dock trials correspond
- Average layer correction = 0.3 Dn50 for multibeam
  - Reference = semi-spherical foot
- Precision of stone surveys = 0.3 Dn50 for multibeam
  - Reference = plate
  - Spemi-spherical foot has high ‘in accuracy’ as reference
- More investigation required for Dn50 around 0.25 m

Q1 – 2013 (expected):

New edition of ‘Construction and survey accuracies for the execution of dredging and stone dumping works’

Port of Rotterdam

PROJECTORGANISATIE MAASVLAKTE 2

Questions?

Thank you for your attention