

塑造智慧变革



HEXAGON

海克斯康



北京
国家会议中心

2018年

9月10-12日

2018.hexagonchina.com.cn

自动化监测与人工监测的桥梁 与隧道监测

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FHKIS, FRICS, MNZIS, RISM, FInstICES

國際測量師聯合會FIG 2003-2006 副會長

香港測量師學會會長 1997/98

2016年以來NZIS香港分會主席



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项目背景



中环湾仔绕道及东区走廊通道 (CWB)

是香港岛北岸的一条战略道路，旨在纾缓Gloucester现有道路- Harcourt道- Connaught中心走廊的交通拥堵。在法定程序中重申了这一需要，并在公众参与过程中得到支持。

项目管理:

公路部门

咨询工程公司:

AECOM 亚洲有限公司.

预算项目成本:

港币360 亿元

建筑开工日期:

2009年12月

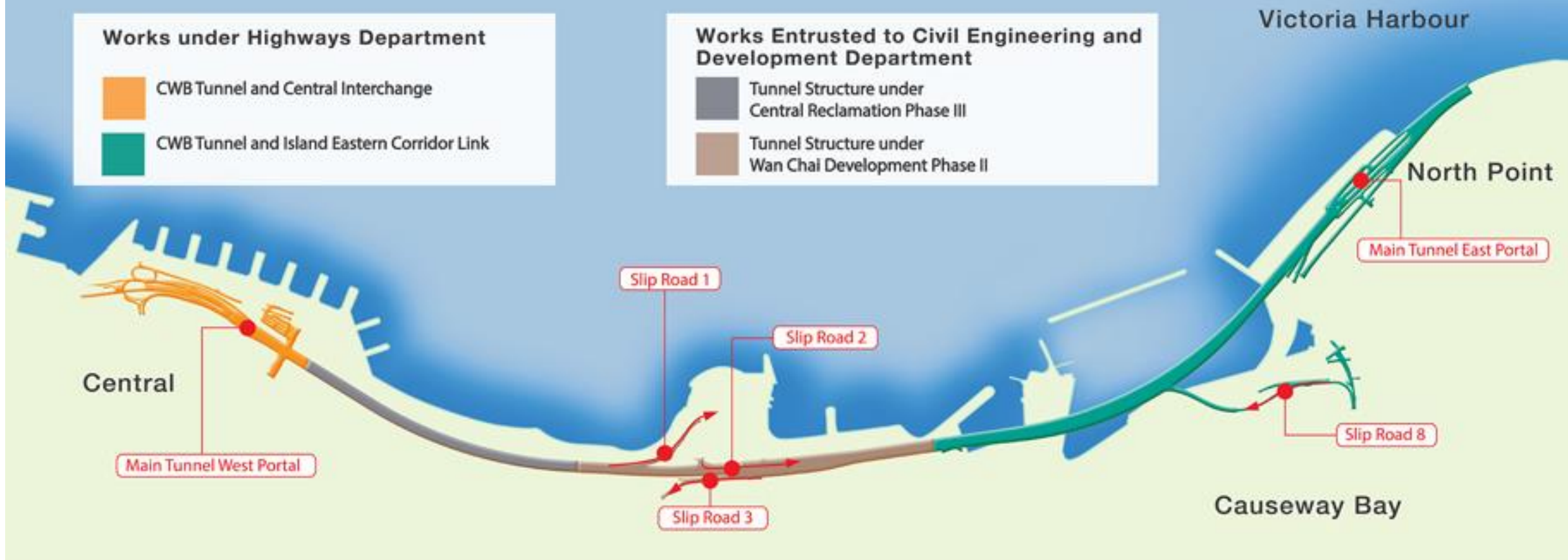
预计投产日期:

2018年末 / 2019年第一季度

项目背景

- 中环湾仔绕道及东岛走廊连接线

Central - Wan Chai Bypass and Island Eastern Corridor Link



ADMS 测量 – 设站点 1 (临时设置)

We have
Computer, UPS,
communication
device, Geomos
Monitor and
Geomos Analysis
inside the box

我们使用了计算机、
UPS\通讯设备、
GeoMoS的监测器
和分析器。都安装
在这个箱子里。



ADMS 测量 – 设站点 1 (临时设置)



Monitoring Prism
监测棱镜



ADMS 测量-设站点 1 (永久设置)

This is Permanent Setup
这是永久设站点



This is Temporary Setup
这是临时设站点

ADMS 测量-设站点 1 (永久设置)



ADMS 测量-设站点 2

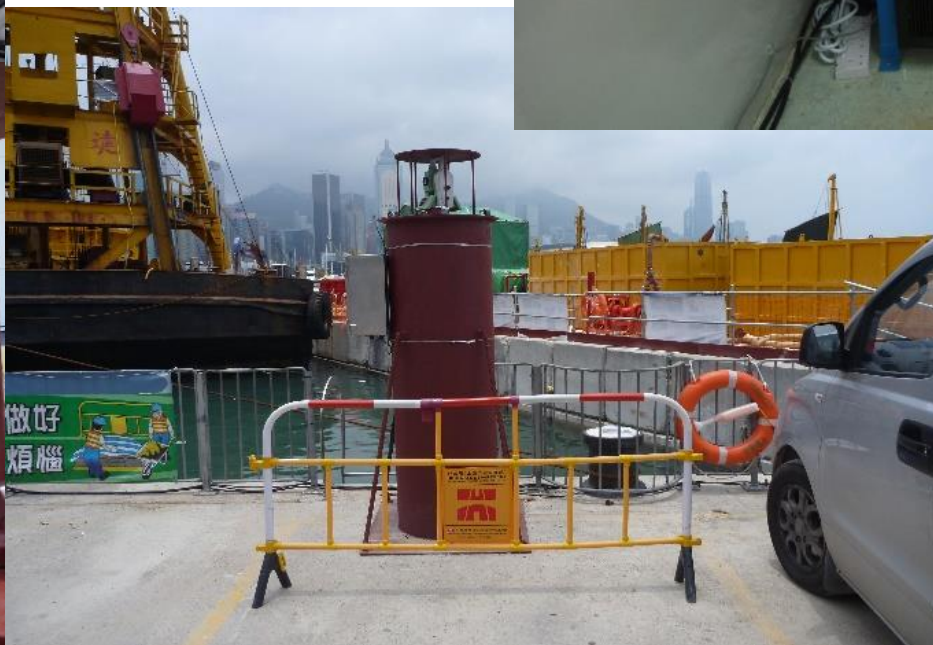


ADMS 测量 – 设站点 2



We have
Computer, UPS,
Geomos Monitor
and Geomos
Analysis inside
the box

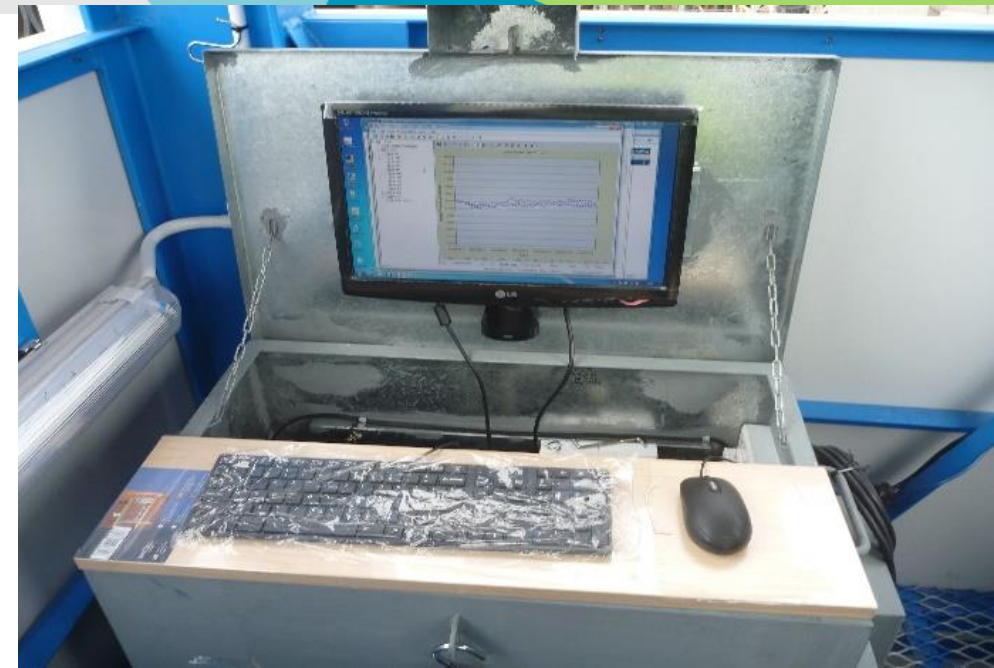
在箱子里安装了
电脑、UPS、
GeoMoS的监测
器和分析器



ADMS 测量- 设站点 3



ADMS 测量 - 设站点 3



ADMS 测量 - 设站点 4



ADMS 测量 – 设站点 4



ADMS 测量 – 设站点 5 (CHT1)



ADMS 测量 – 设站点 5



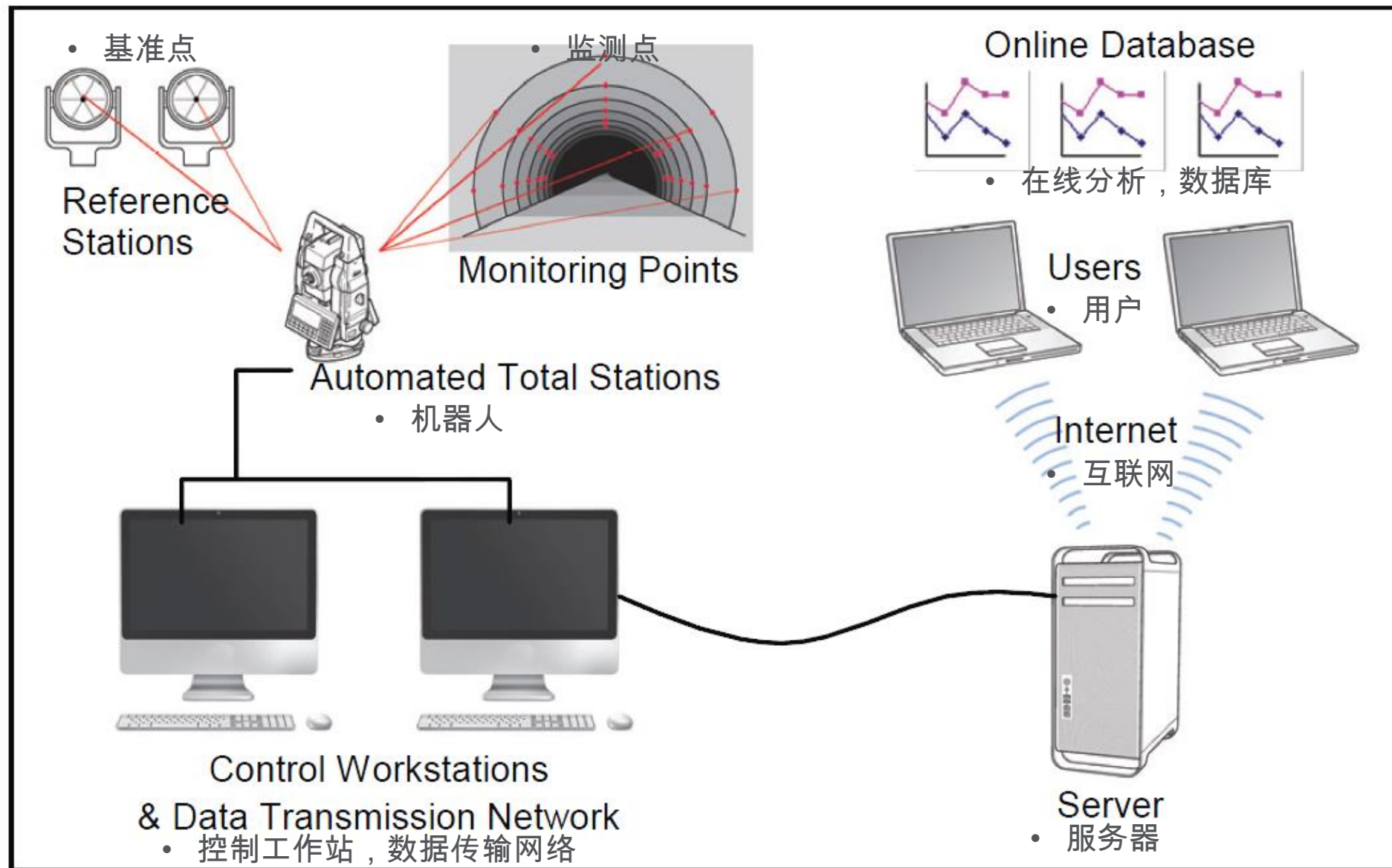
Reference Prism
基准棱镜



Monitoring Prism
监测棱镜

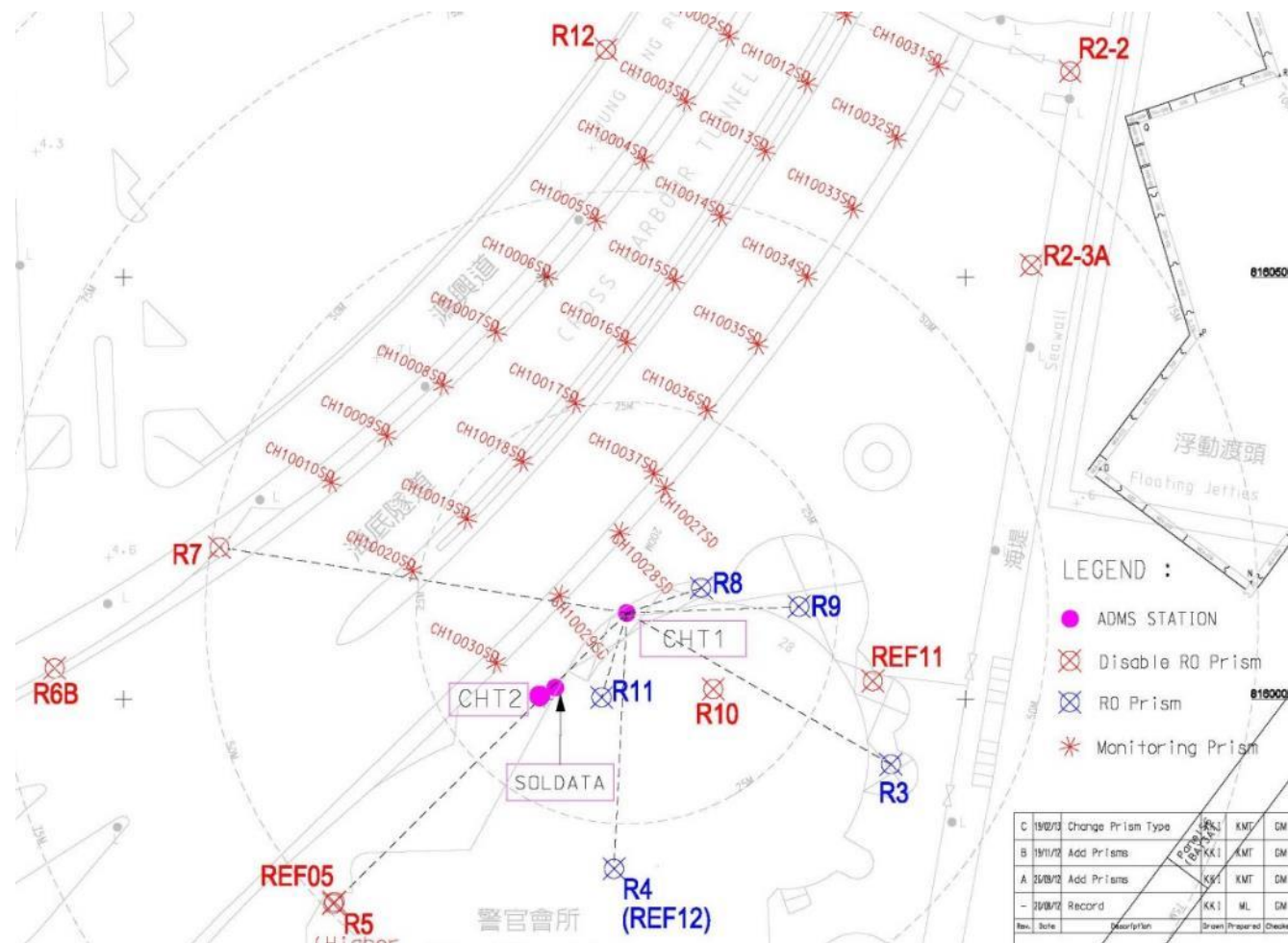


ADMS 测量 – 设站点5 (系统组成)



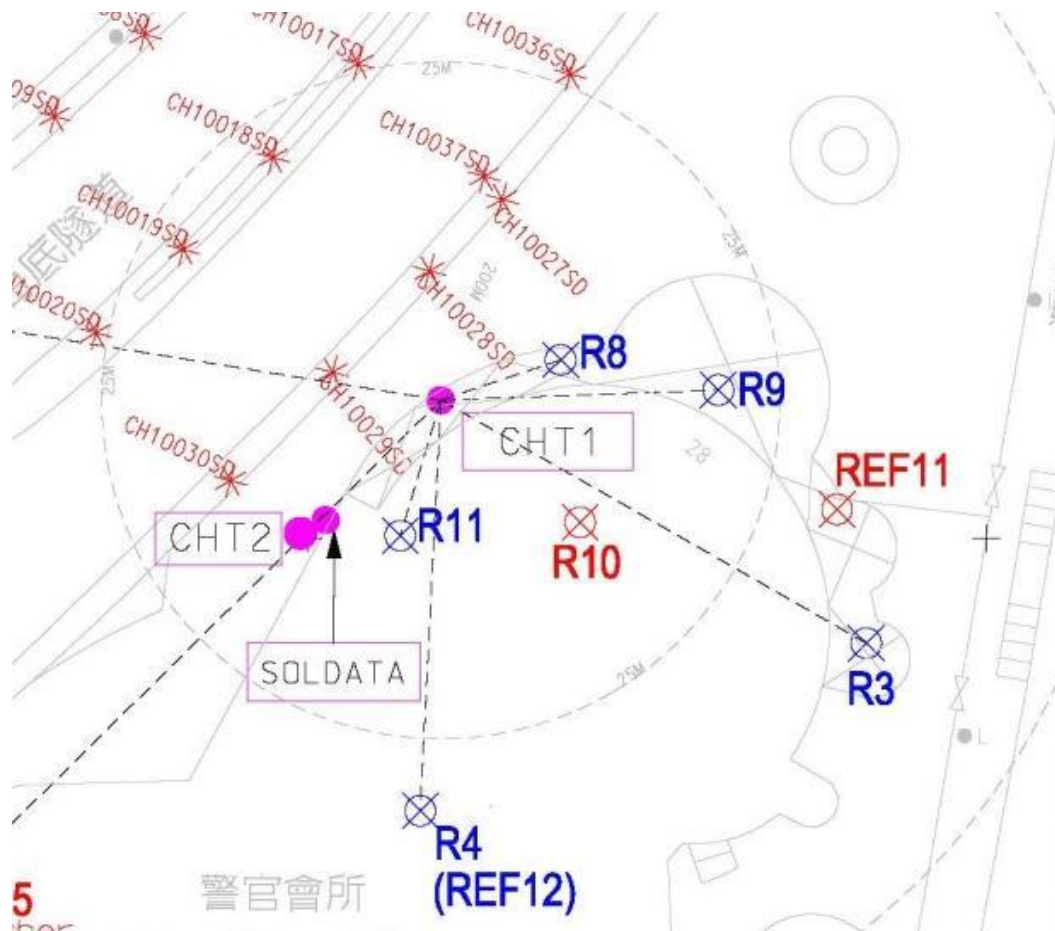
ADMS 测量 – 设站点 5 (网络设计)

- 最少5个点
- 等边三角形,
- 角度大小: 大于 30° ; 小于 120°
- 覆盖监测区域



ADMS 测量 – 设站点 5 (自由设站)

- 从无坐标的站点，测量坐标系中的已知点

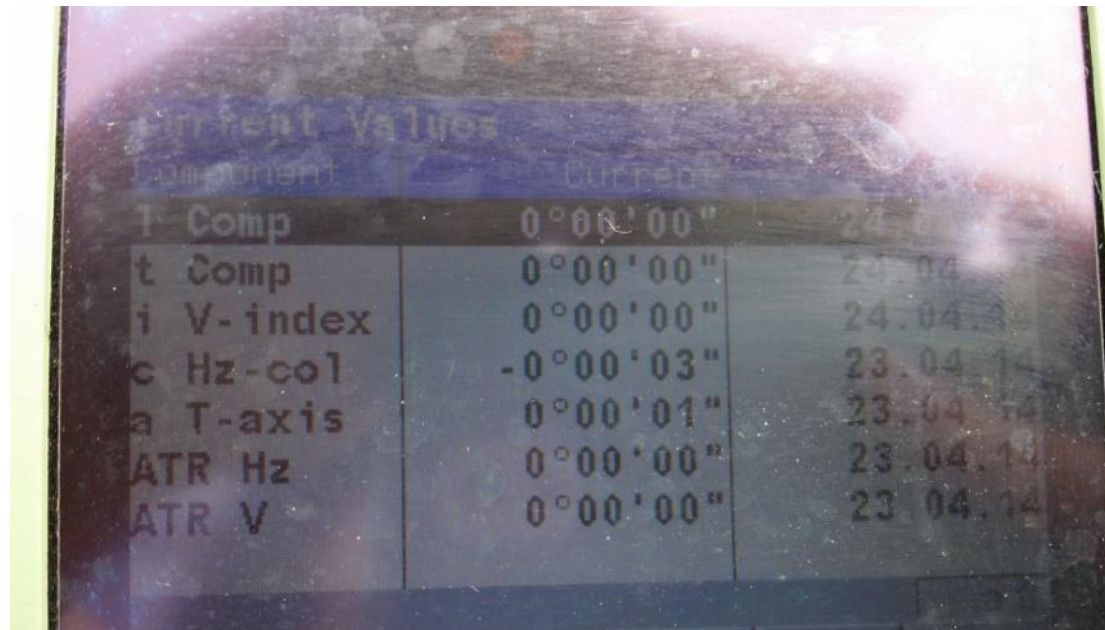


ADMS 测量 – 设站点 5 (独立检查)

- 每月核实监测数据
→对ADMS产生的数据进行核对
- 使用常规测量技术进行人工检查
 - 导线
 - 水准测量

ADMS 测量 – 设站点 5 (质量控制)

- 维护/年度校准
- 基准和监测棱镜的清洗
- 全站仪标定
 - 补偿器指标误差
 - 垂直指标误差
 - 水平准直误差
 - ATR水平角和ATR竖直角



Component	Current	
I Comp	0°00'00"	24.04.14
t Comp	0°00'00"	24.04.14
i V-index	0°00'00"	24.04.14
c Hz-col	-0°00'03"	23.04.14
a T-axis	0°00'01"	23.04.14
ATR Hz	0°00'00"	23.04.14
ATR V	0°00'00"	23.04.14

I, t

Compensator longitudinal and transversal index errors

i

Vertical index error, related to the standing axis

c

Horizontal collimation error, also called line of sight error

ATR Hz

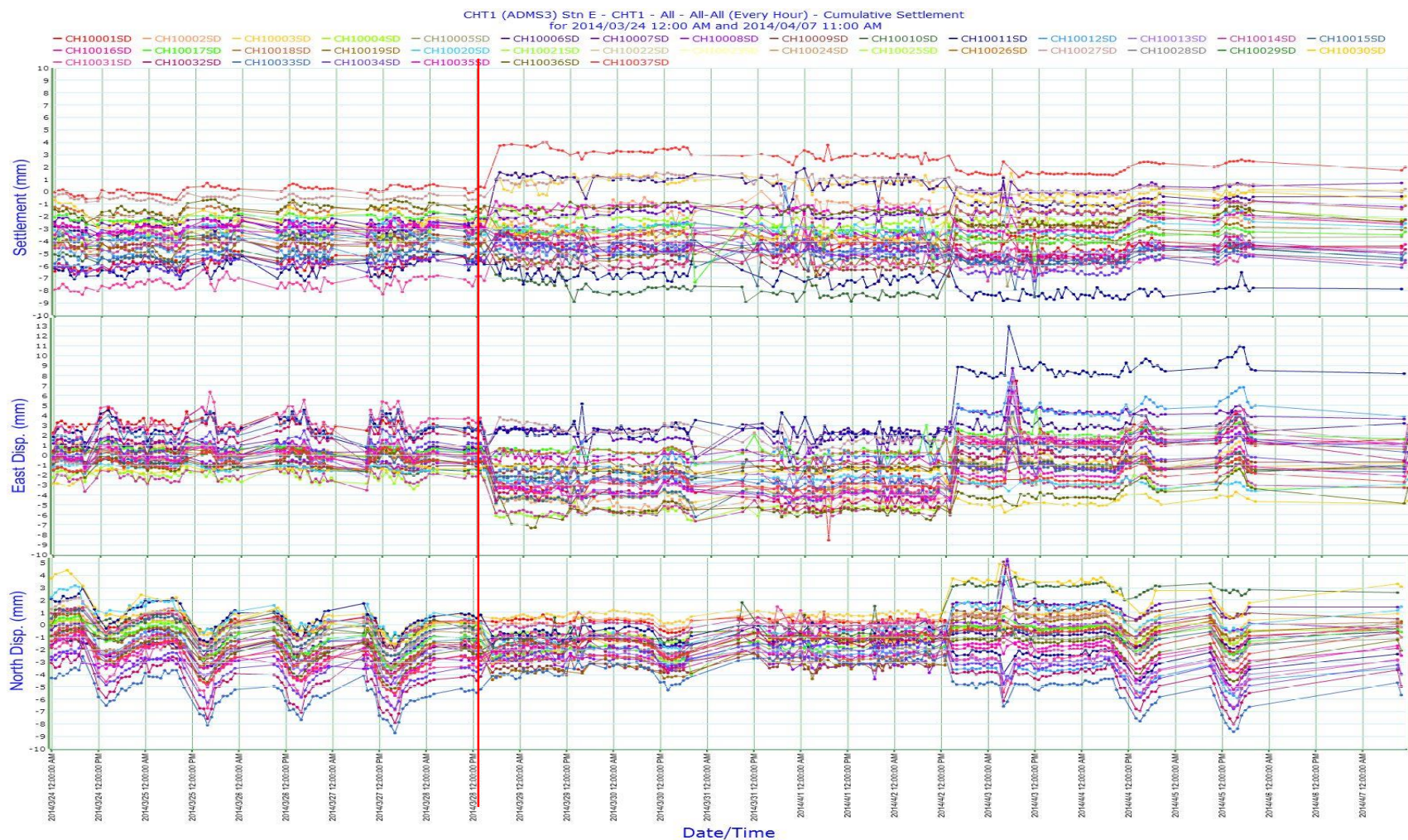
ATR zero point error for horizontal angle option

ATR V

ATR zero point error for vertical angle option

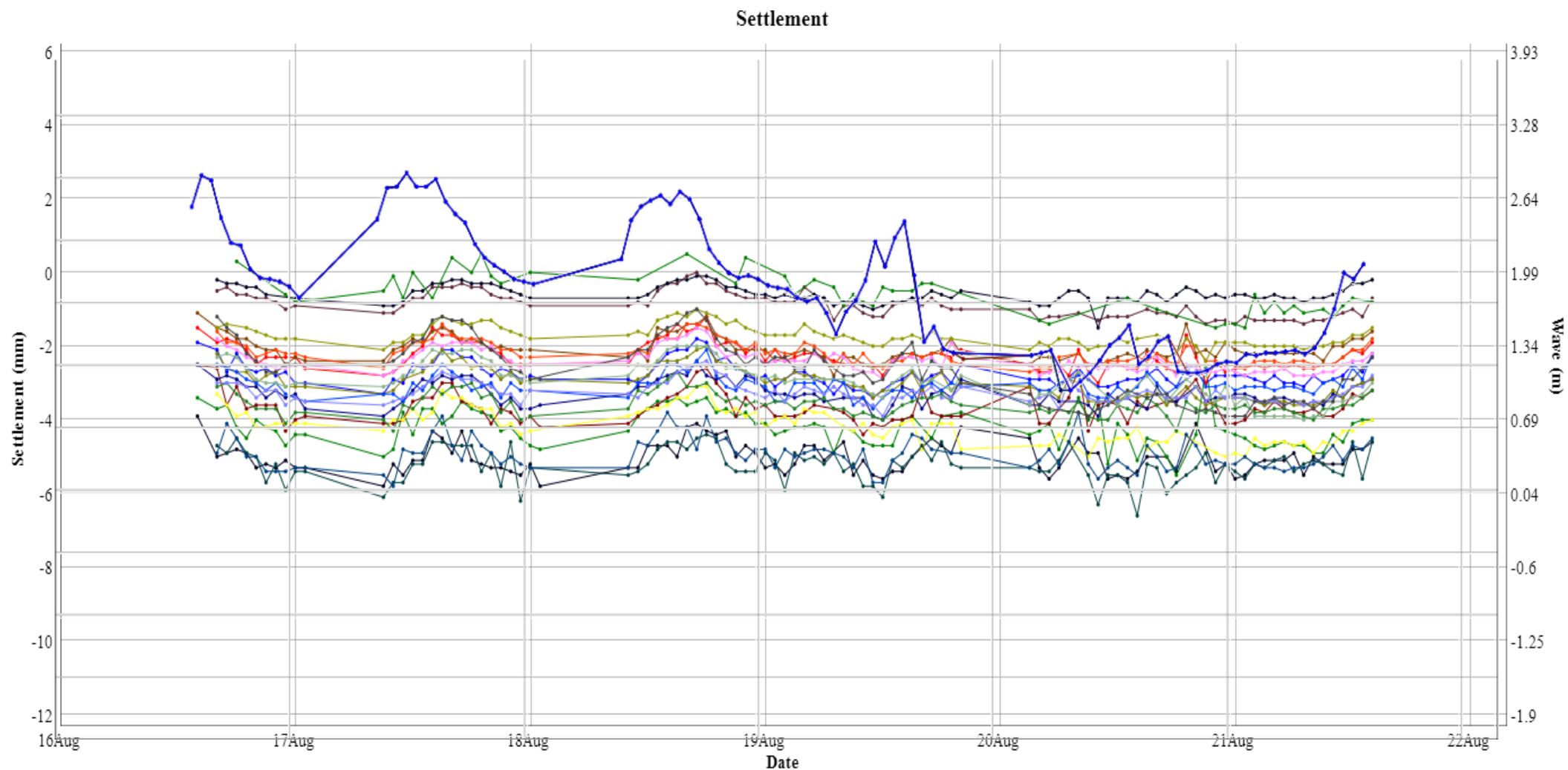
ADMS 测量 – 设站点 5 (实施阶段)

- 情况: 增加 PVC 罩子



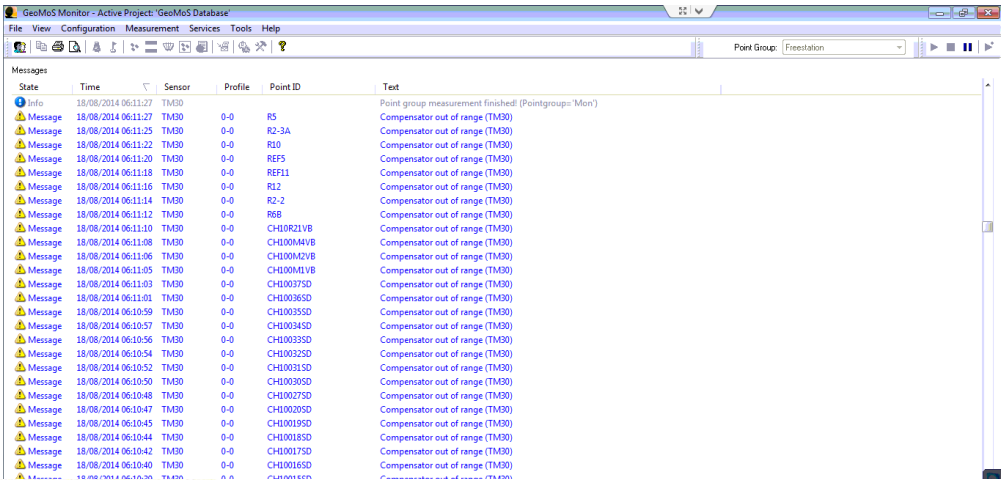
ADMS 测量 – 设站点 5 (实施阶段)

- 情况：温度影响

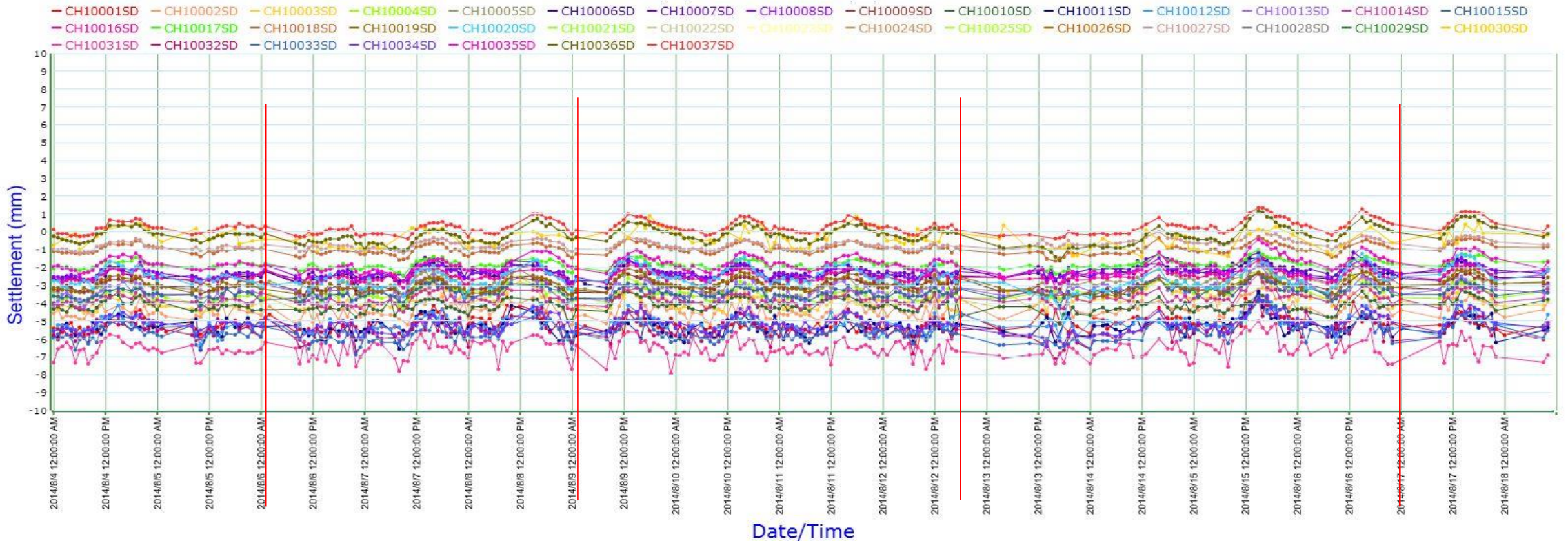


ADMS 测量 – 设站点 5 (实施阶段)

- 情况：
补偿器超限

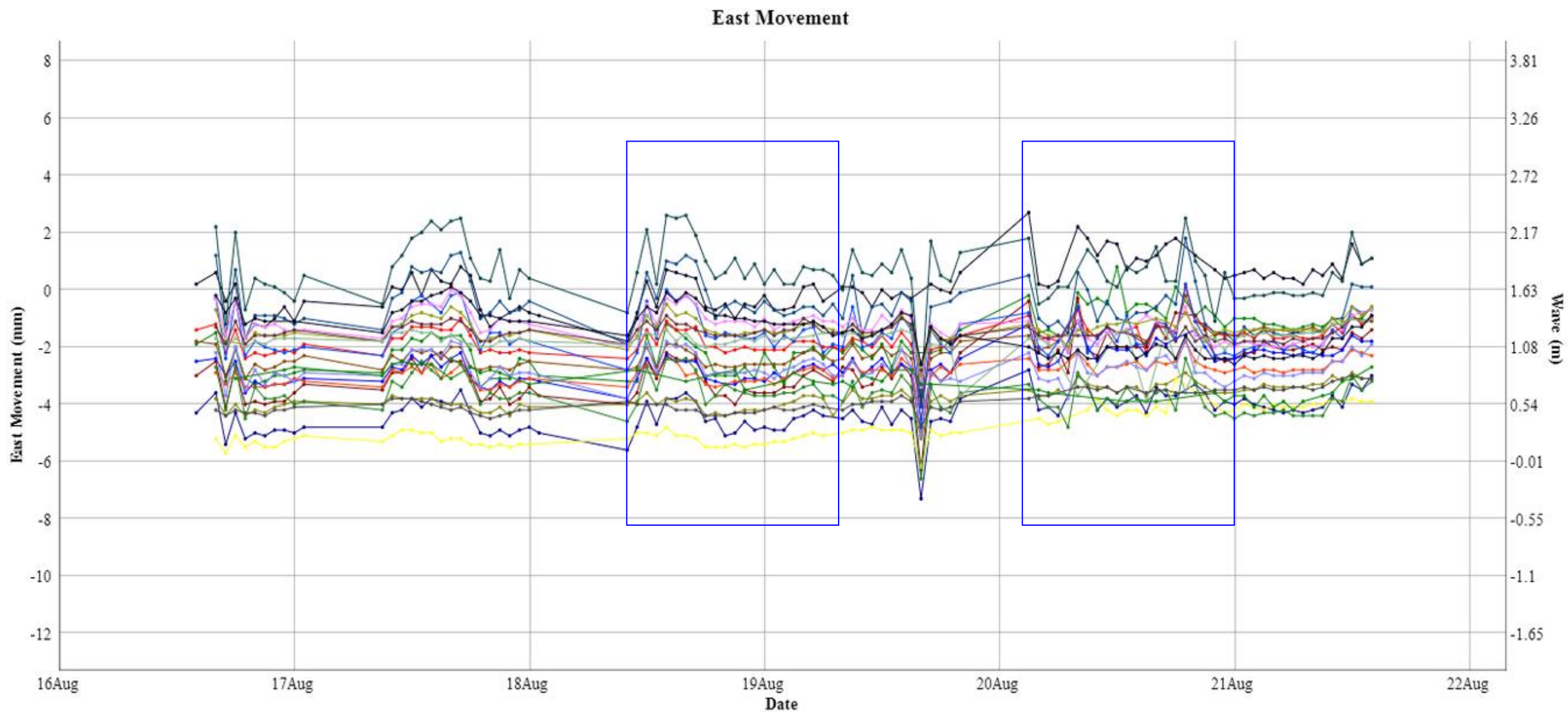


CHT1 (ADMS3) Stn E - CHT1 - All - All-All (Every Hour) - Cumulative Settlement
for 2014/08/04 12:00 AM and 2014/08/18 11:00 AM



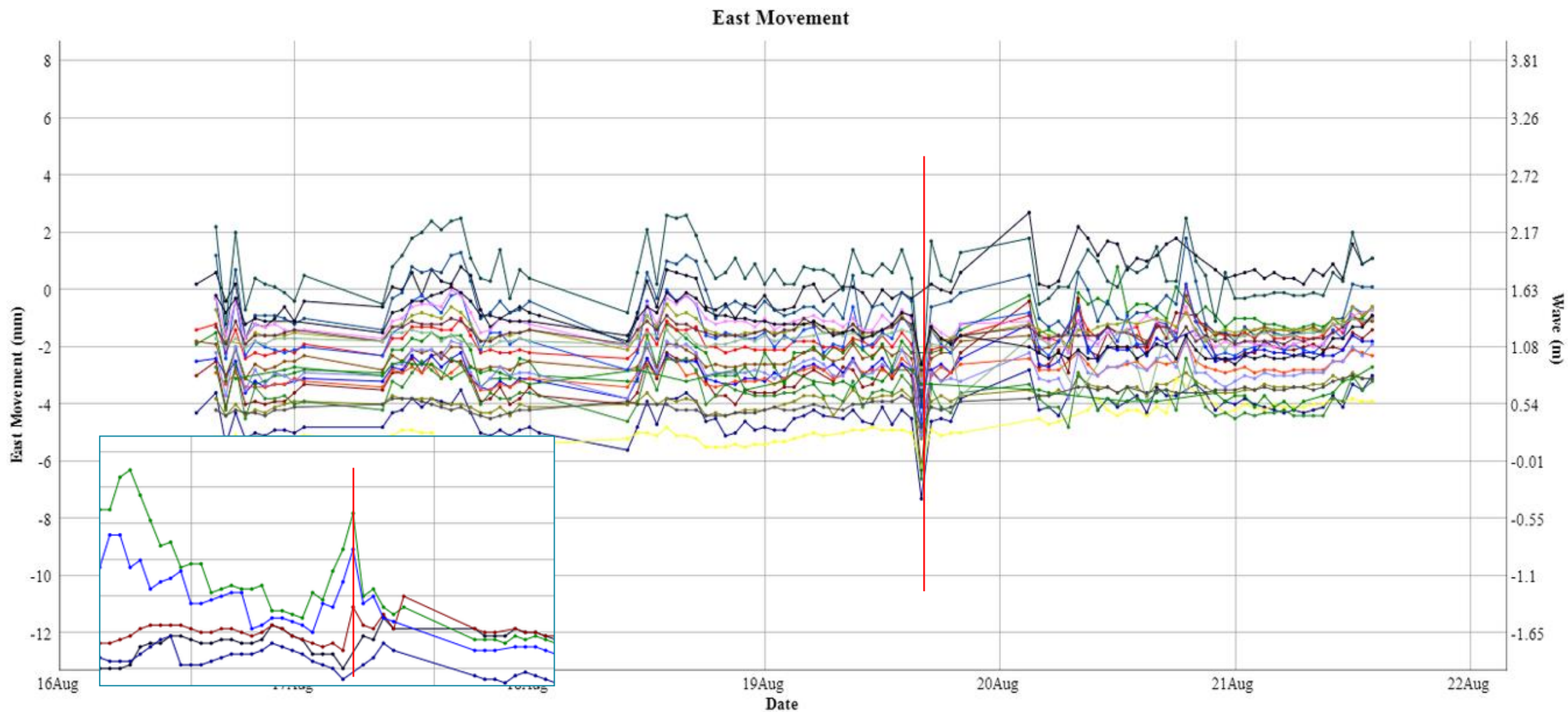
ADMS 测量 – 设站点 5 (实施阶段)

- 情况：极端天气



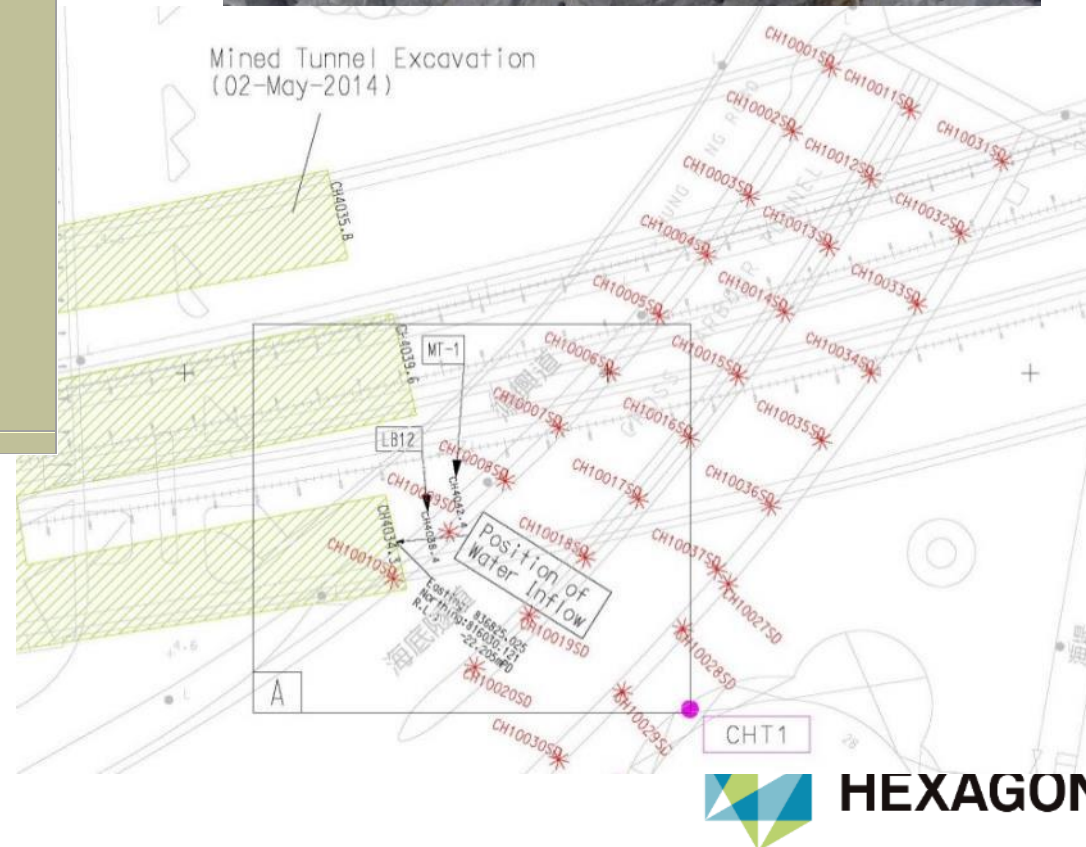
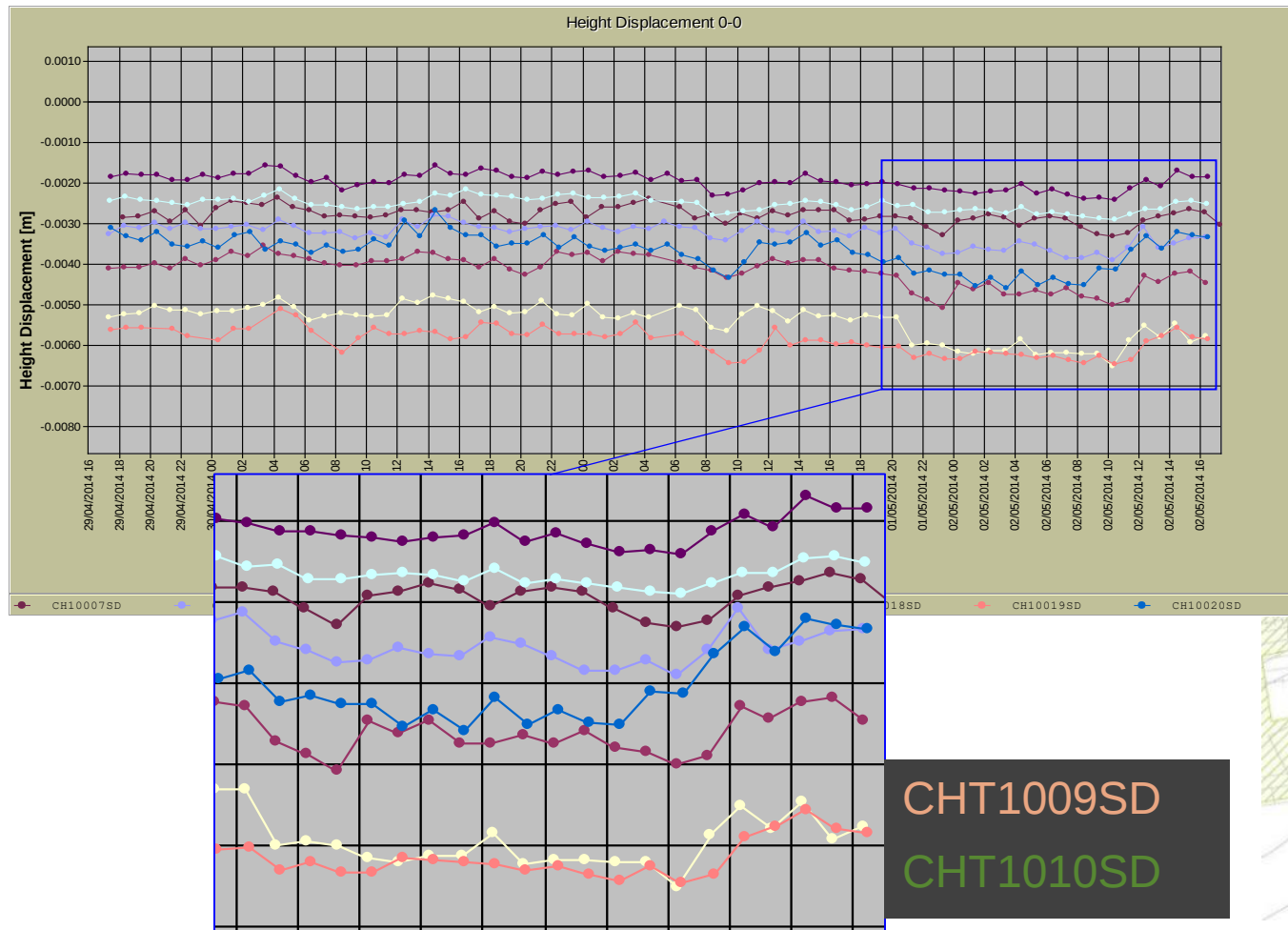
ADMS 测量 – 设站点 5 (实施阶段)

- 情况：自由设站条件不足

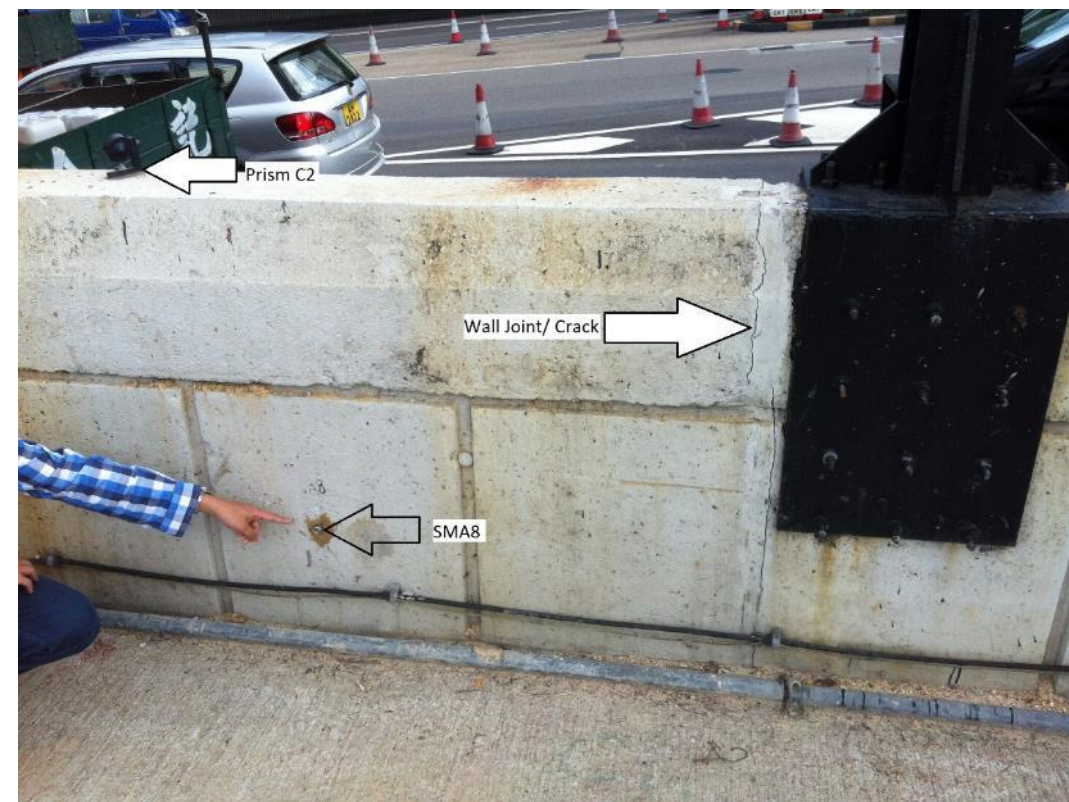


ADMS 测量 – 设站点 5 (实施阶段)

- 情况: 采空区涌水量



人工测量检查



人工测量检查



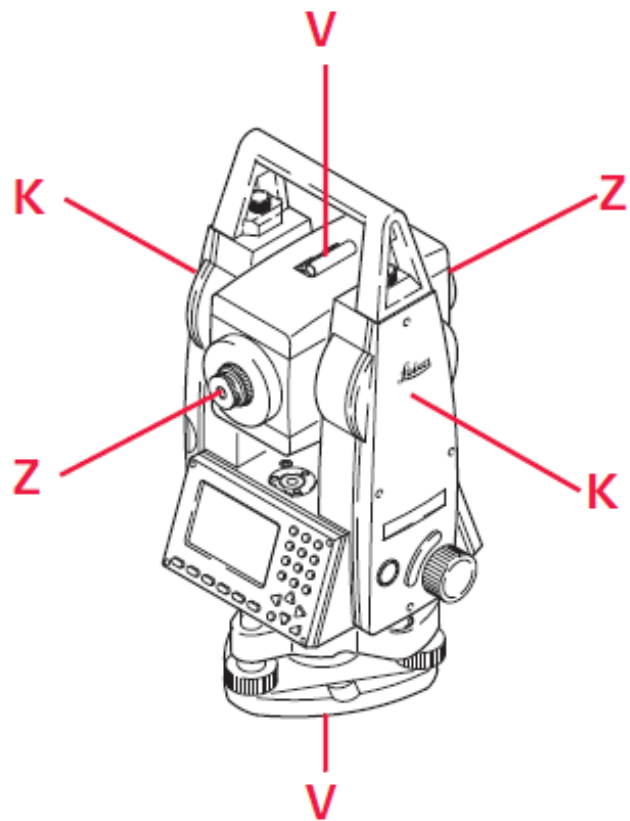
人工测量检查



4 圆 4 弧 精密测量

- ▶ 盘左& 盘右测量
- ▶ 4 圆 4 弧 (即在不同测回间配置水平度盘的方法)
- ▶ 水平角闭合(水平角度闭合方法)

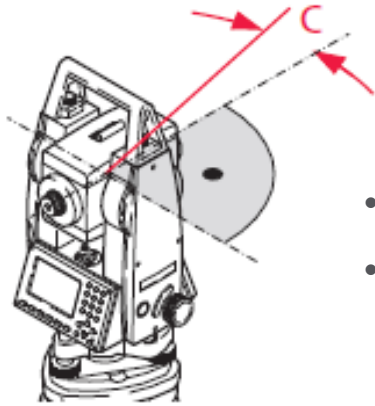
4 圆 4 弧精密测量 – 盘左盘右观测



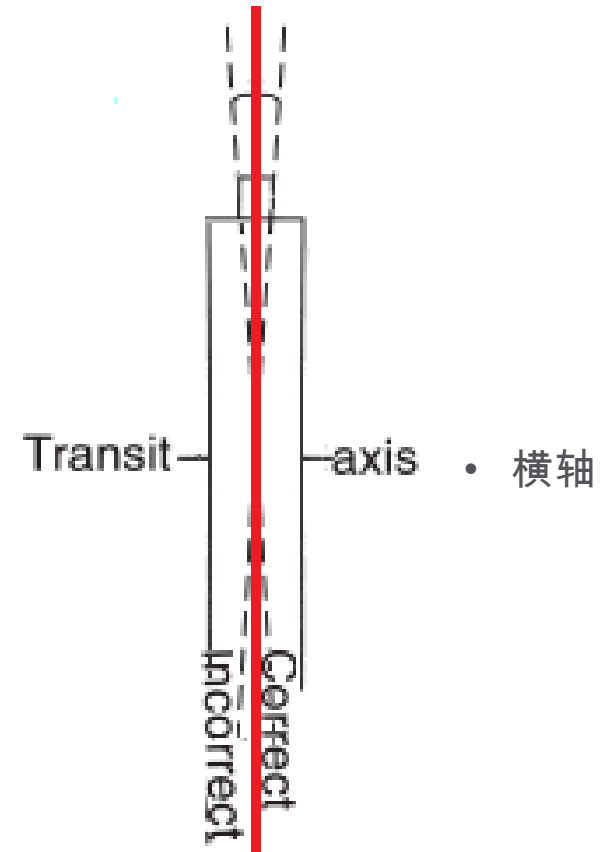
► 消除误差

- a) 视线Z Z垂直于横轴 K K
- b) 横轴KK垂直于垂直轴V V
- c) 垂直轴V V严格垂直
- d) 竖盘在天顶精确读零

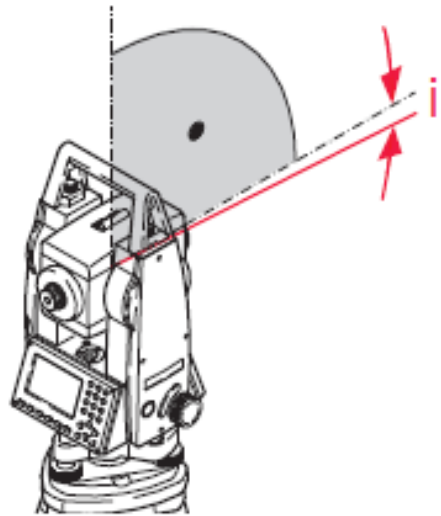
4 圆 4 弧精密测量 – 准直误差



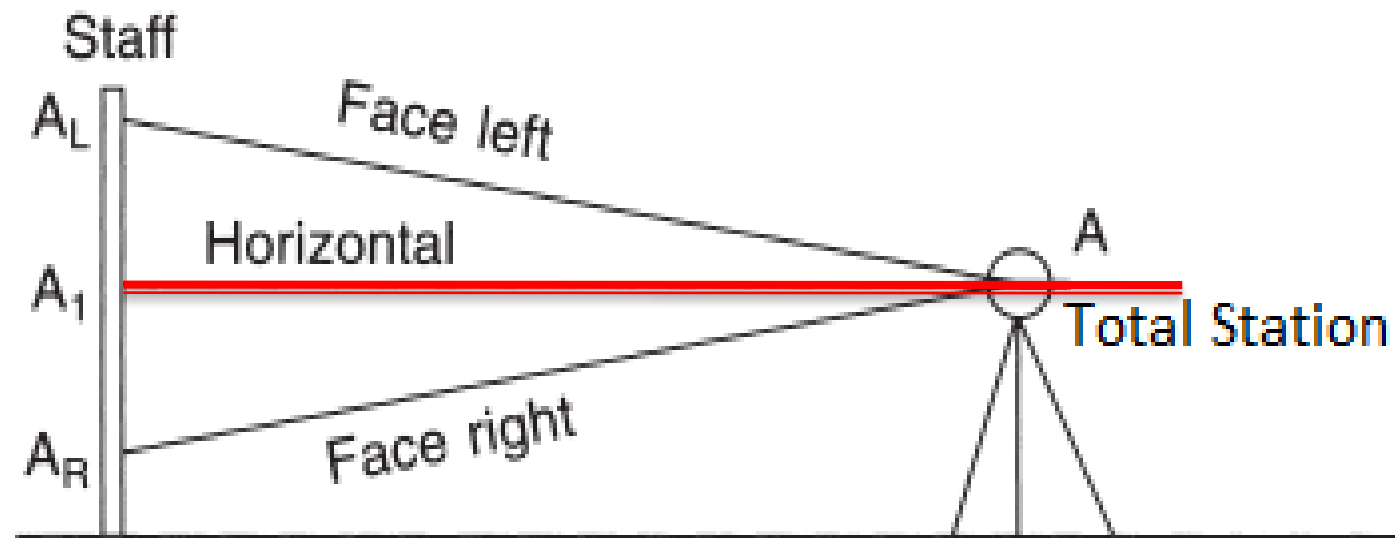
- 视线误差 (C)
- (水平角准直)



4圆 4 弧精密测量 - 高度指数误差

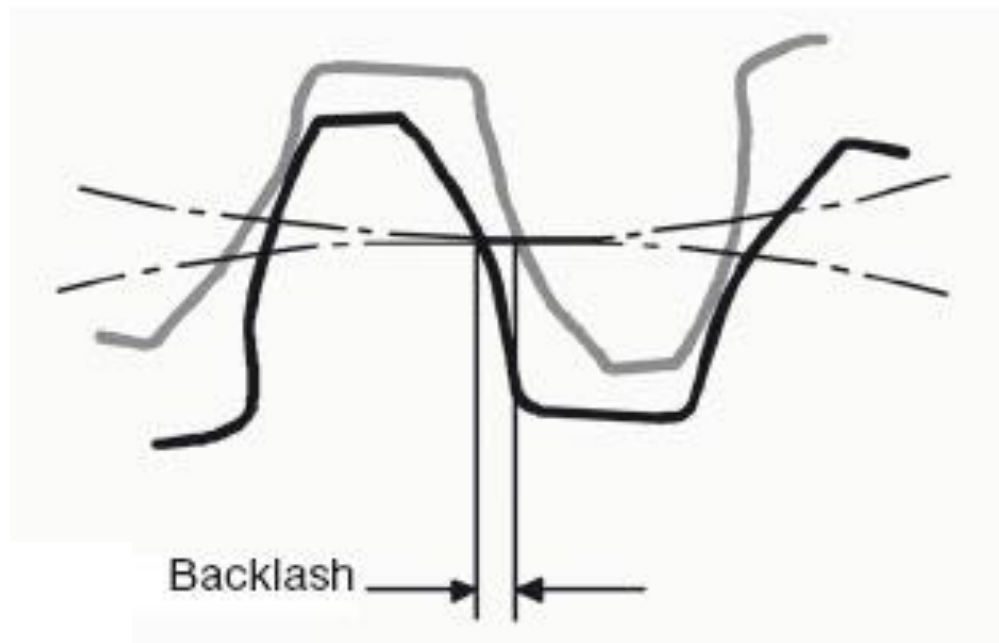
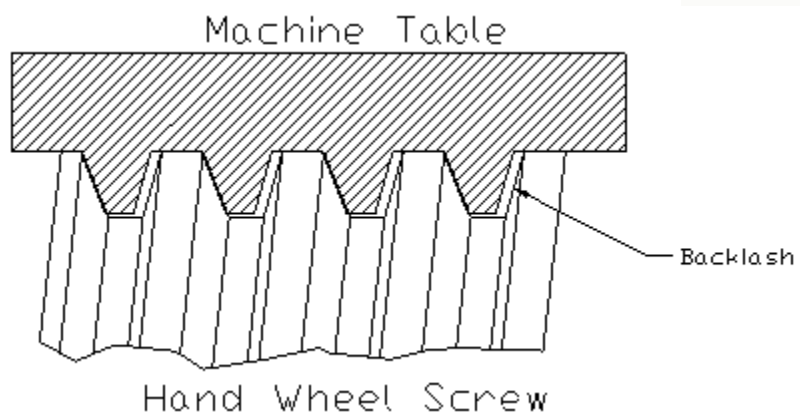


- 高度指数误差 (i)
- 竖盘指标



4圆 4 弧精密测量 – 齿隙

- ▶ 齿隙是在一对齿轮之间形成的间隙。



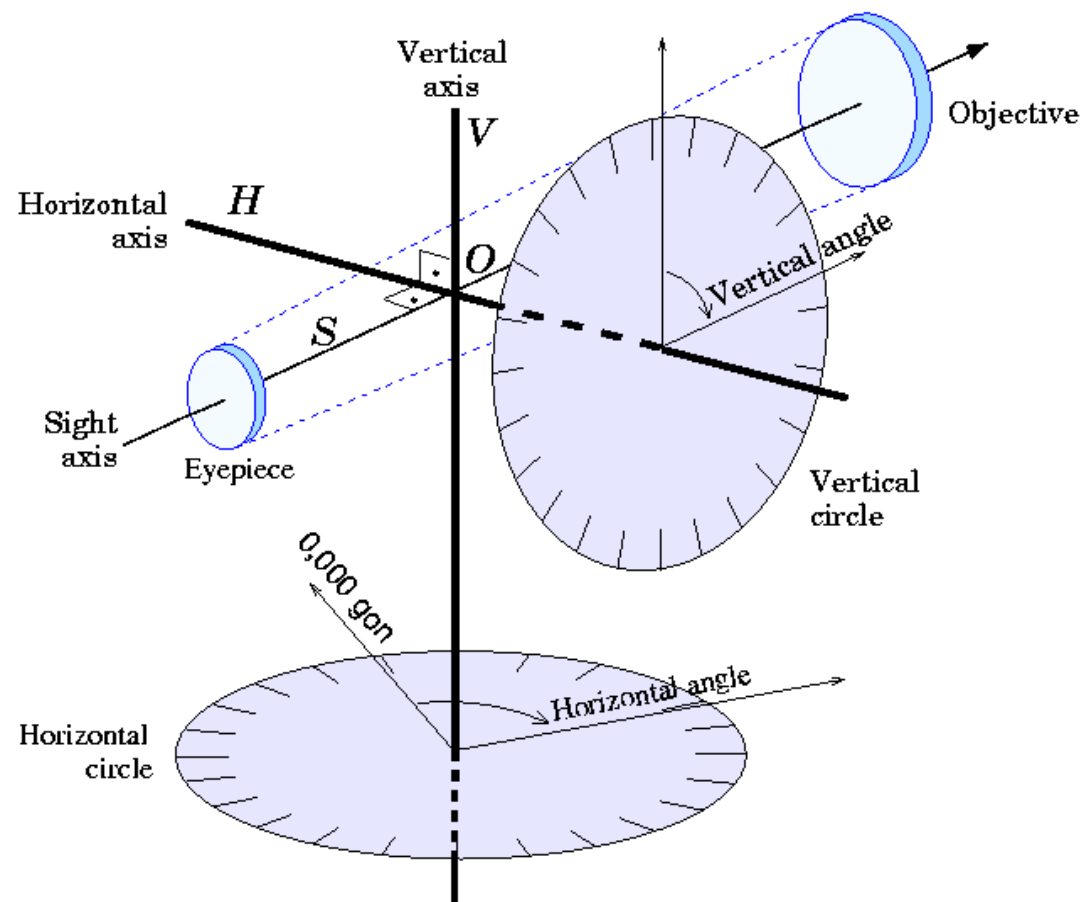
4圆 4 弧精密测量 – 齿隙

- ▶ 盘左观察：总是顺时针方向转动
- ▶ 盘右观察：总是逆时针方向转动.

4圆 4 弧精密测量

- ▶ 消除度盘刻度误差
- ▶ 计算 S.Dev

$$\sigma = \sqrt{\frac{1}{N} \sum_{i=1}^N (x_i - \bar{x})^2}$$



4圆 4 弧精密测量 (配置水平度盘)

▶ 盘左:

000-00-00

090-00-00

045-00-00

135-00-00

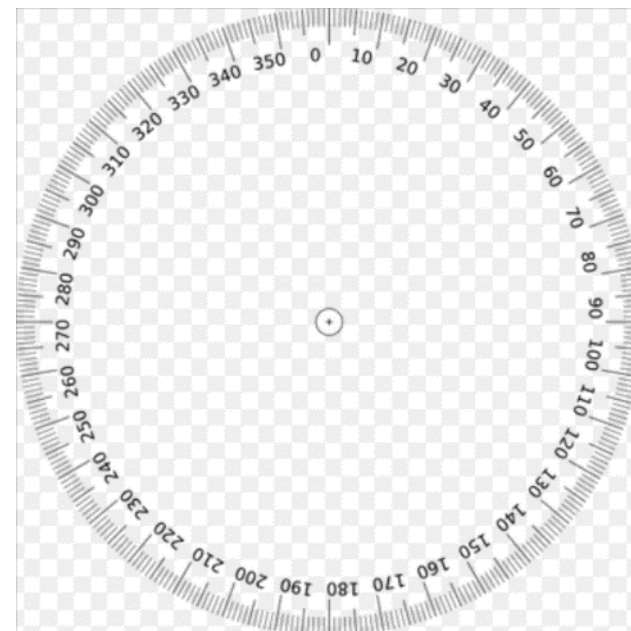
盘右:

180-00-00

270-00-00

225-00-00

315-00-00

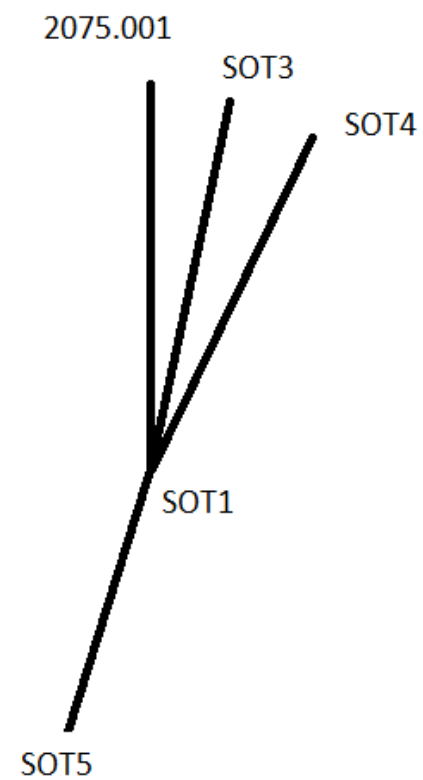


4圆 4 弧精密测量 - 水平角闭合

- ▶ 确保全站仪在观测过程中没有被移动。
- ▶ 检查它是否是 360°

4圆 4 弧精密测量

		Observation (DD.MMSS)
@ At STN:	SOT1	
STN:	1L	
RO	2075.001	0.0000
	SOT3	
	SOT4	
	SOT5	
	2075.001	

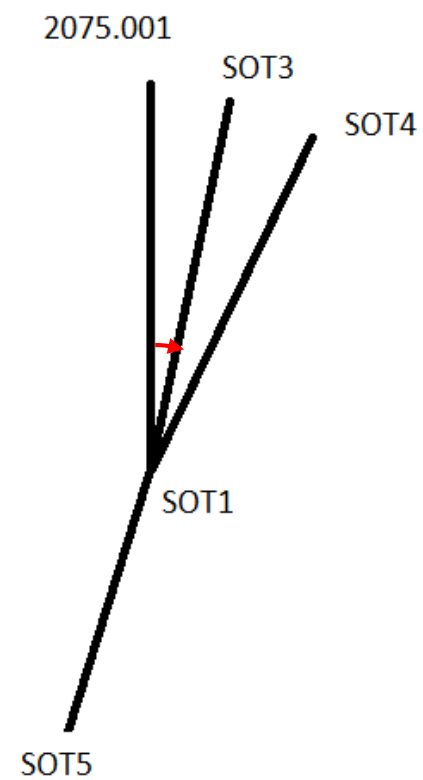


- 盘左，顺时针观测

4圆 4 弧精密测量

		Observation (DD.MMSS)
@ At STN:	SOT1	
	STN:	1L
RO	2075.001	0.0000
	SOT3	8.1649
	SOT4	
	SOT5	
	2075.001	

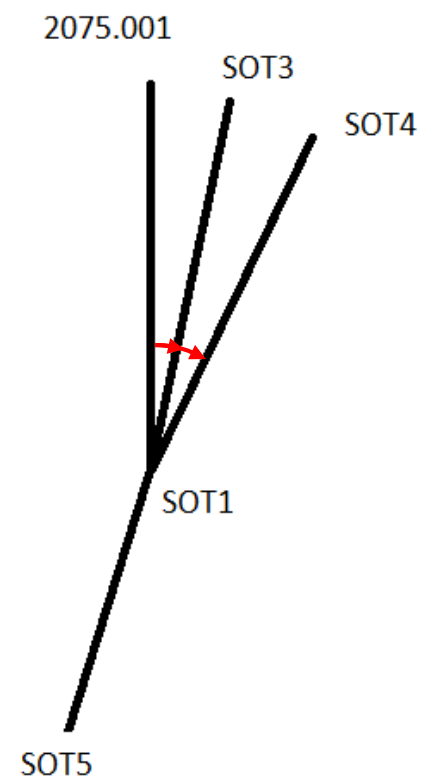
- 盘左，顺时针观测



4圆 4 弧精密测量

		Observation (DD.MMSS)
@ At STN:	SOT1	
	STN:	1L
RO	2075.001	0.0000
	SOT3	8.1649
	SOT4	22.4313
	SOT5	
	2075.001	

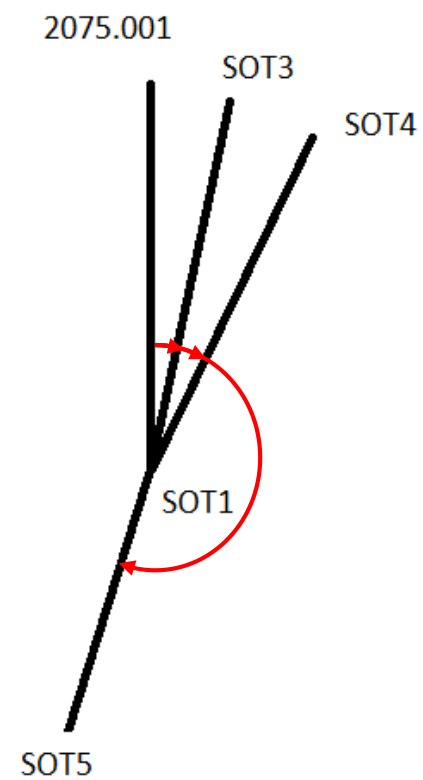
- 盘左，顺时针观测



4圆 4 弧精密测量

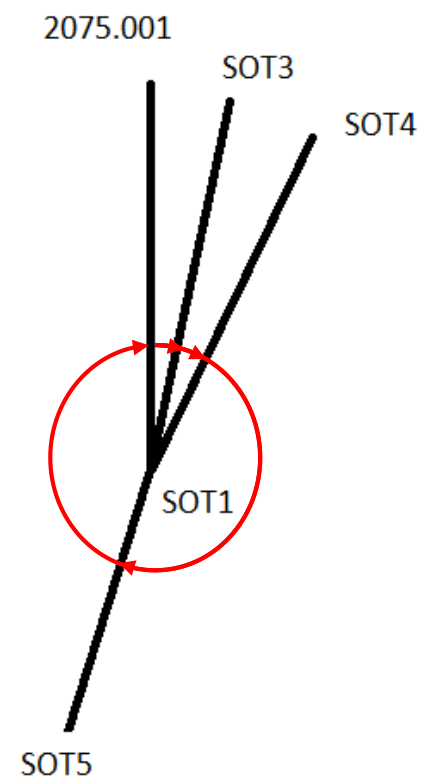
		Observation (DD.MMSS)
@ At STN:	SOT1	
STN:	1L	
RO	2075.001	0.0000
	SOT3	8.1649
	SOT4	22.4313
	SOT5	192.4116
	2075.001	

- 盘左，顺时针观测



4圆 4 弧精密测量

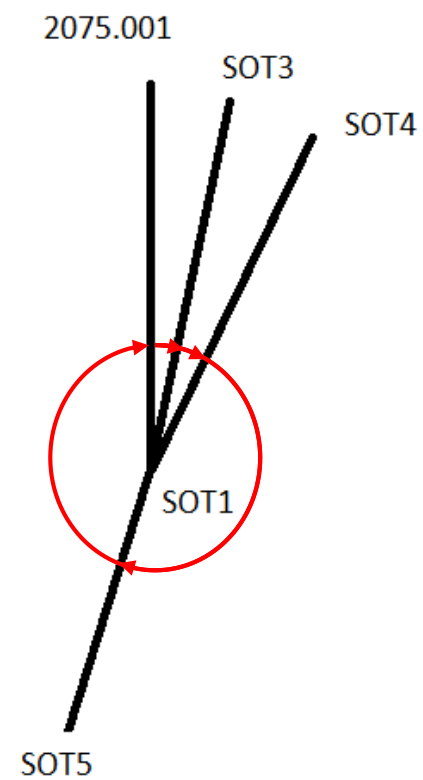
		Observation (DD.MMSS)
@ At STN:	SOT1	
	STN:	1L
RO	2075.001	0.0000
	SOT3	8.1649
	SOT4	22.4313
	SOT5	192.4116
	2075.001	359.5958



- 盘左，顺时针观测

4圆 4 弧精密测量

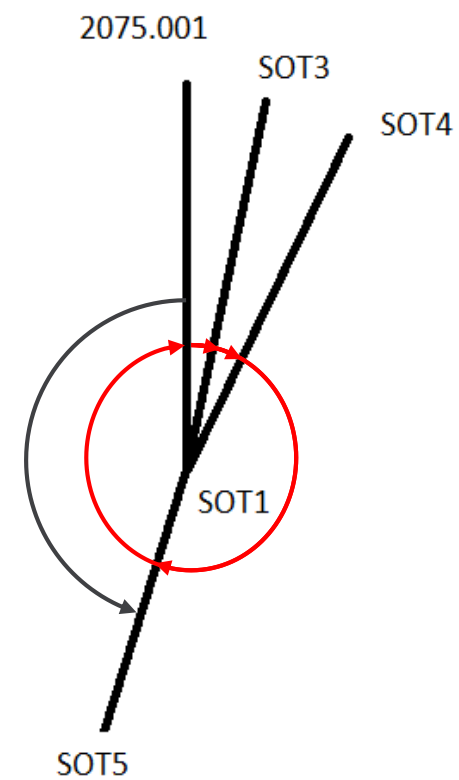
		Observation (DD.MMSS)	
@ At STN:	SOT1		
	STN:	1L	
RO	2075.001	0.0000	
	SOT3	8.1649	
	SOT4	22.4313	
	SOT5	192.4116	
	2075.001	359.5958	180.0002



- 盘右，逆时针观测

4圆 4 弧精密测量

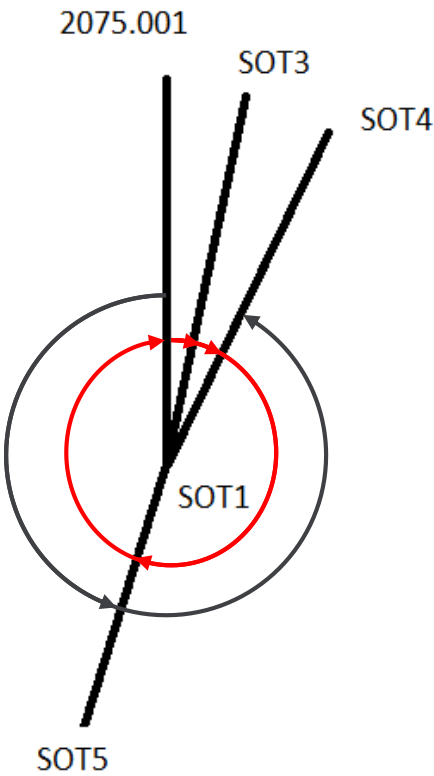
		Observation (DD.MMSS)	
@ At STN:	SOT1		
	STN:	1L	
RO	2075.001	0.0000	
	SOT3	8.1649	
	SOT4	22.4313	
	SOT5	192.4116	12.4116
	2075.001	359.5958	180.0002



- 盘右，逆时针观测

4圆 4 弧精密测量

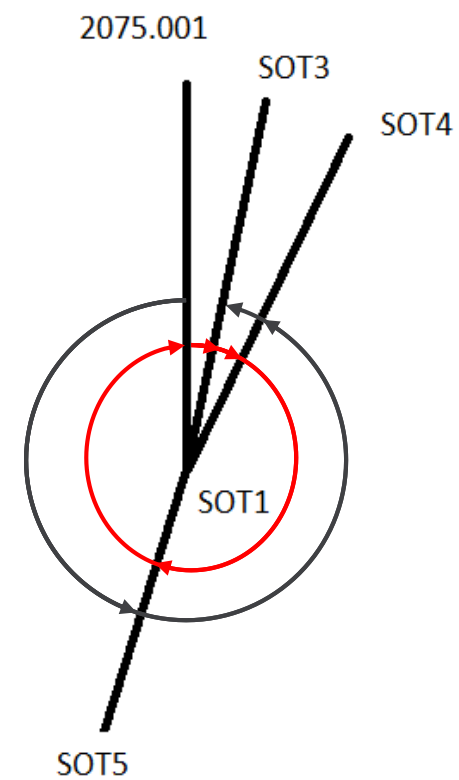
		Observation (DD.MMSS)	
@ At STN:	SOT1		
STN:	1L		
RO	2075.001	0.0000	
	SOT3	8.1649	
	SOT4	22.4313	202.4310
	SOT5	192.4116	12.4116
	2075.001	359.5958	180.0002



- 盘右，逆时针观测

4圆 4 弧精密测量

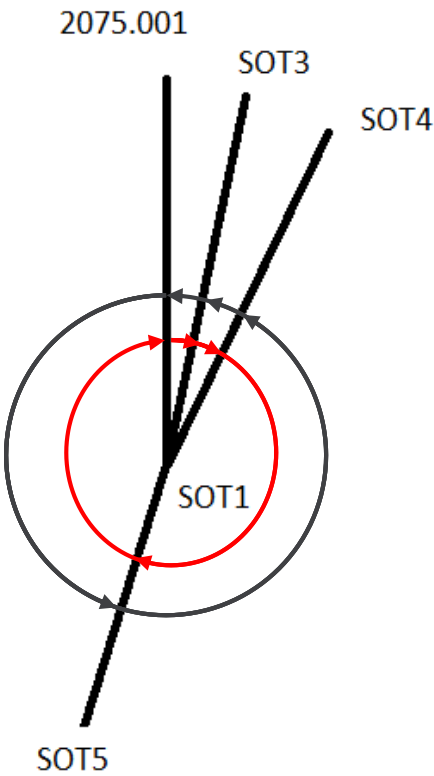
		Observation (DD.MMSS)	
@ At STN:	SOT1		
	STN:	1L	
RO	2075.001	0.0000	
	SOT3	8.1649	188.1639
	SOT4	22.4313	202.4310
	SOT5	192.4116	12.4116
	2075.001	359.5958	180.0002



- 盘右，逆时针观测

4圆 4 弧精密测量

		Observation (DD.MMSS)	
@ At STN:	SOT1		
	STN:	1L	1R
RO	2075.001	0.0000	180.0001
	SOT3	8.1649	188.1639
	SOT4	22.4313	202.4310
	SOT5	192.4116	12.4116
	2075.001	359.5958	180.0002



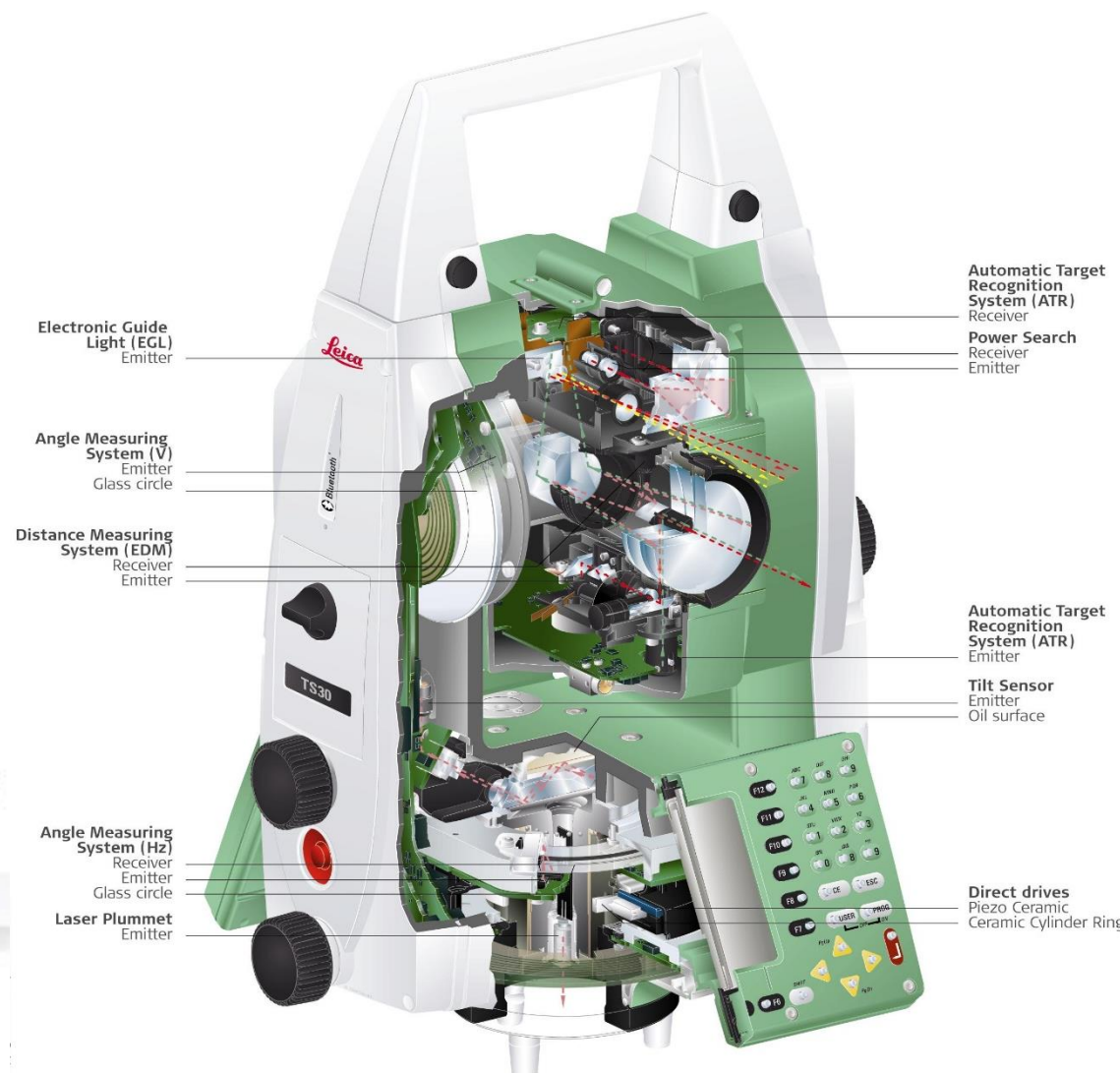
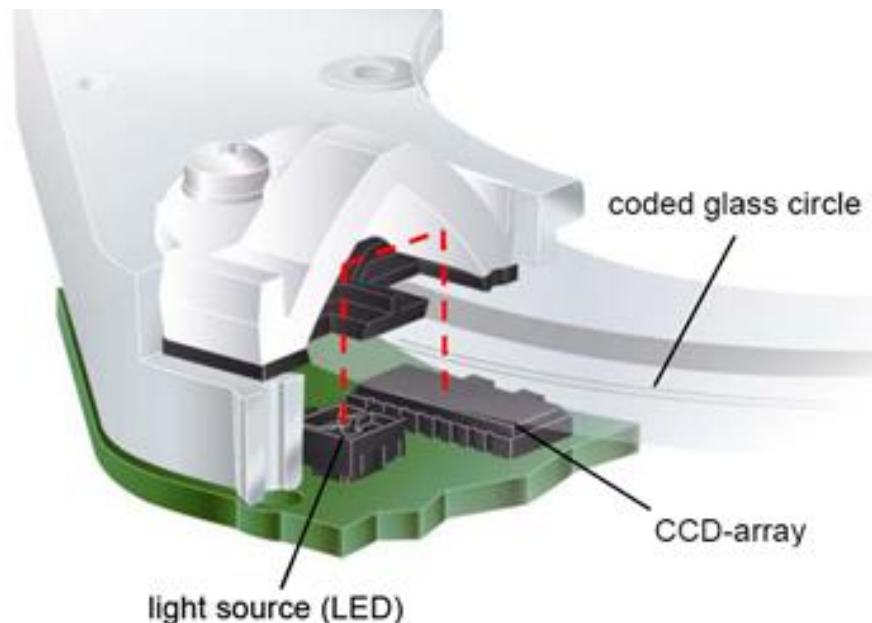
- 盘右，逆时针观测

4图 4 弧精密测量 – TM/S 30/50中的四角检测

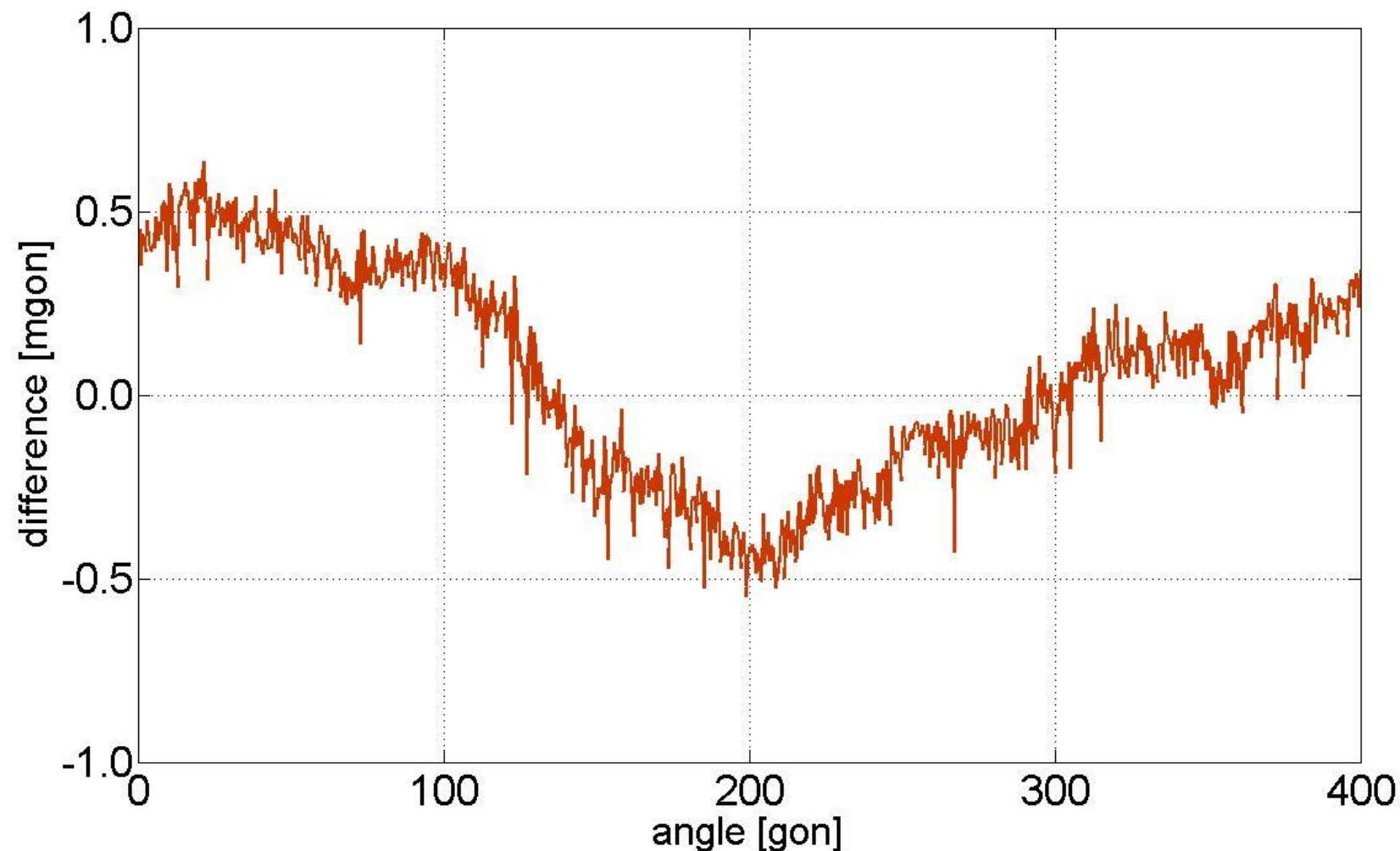
▶ 四角检测

- 4个编码器：消除进一步的 π 周期性误差
- 5000Hz，绝对，连续
- 精度提高约30%

$$\sigma_{4encoder} = \frac{1}{\sqrt{2}} \sigma_{2encoder}$$

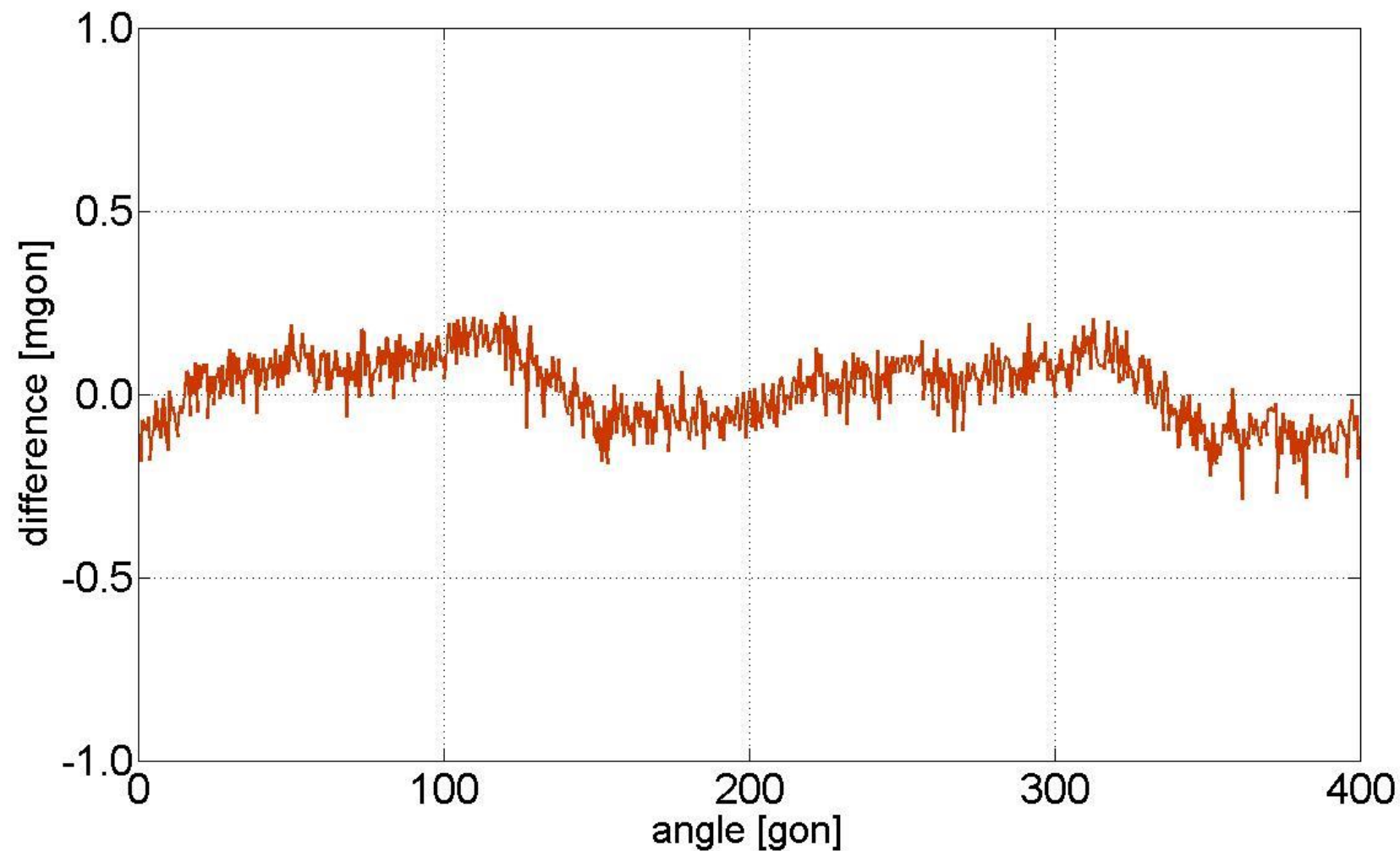


4圆 4 弧精密测量 – TM/S 30/50中的四角检测



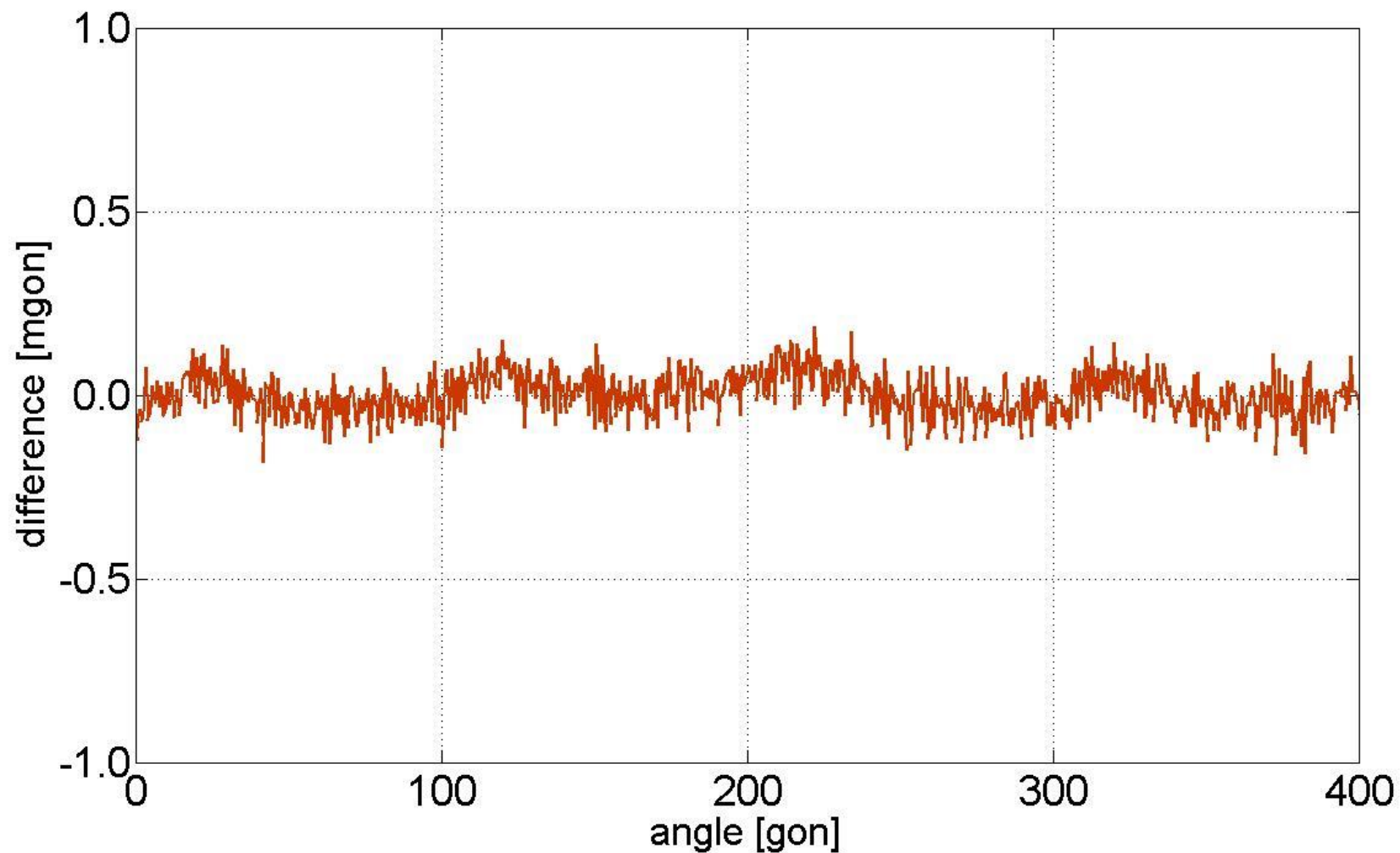
1 Encoder
 $\sigma = 0.981''$ (0.303mgon)

4圆 4 弧精密测量 – TM/S 30/50中的四角检测



2 Encoder
 $\sigma = 0.301''$ (0.093mgon)

4圆 4 弧精密测量 – TM/S 30/50中的四角检测

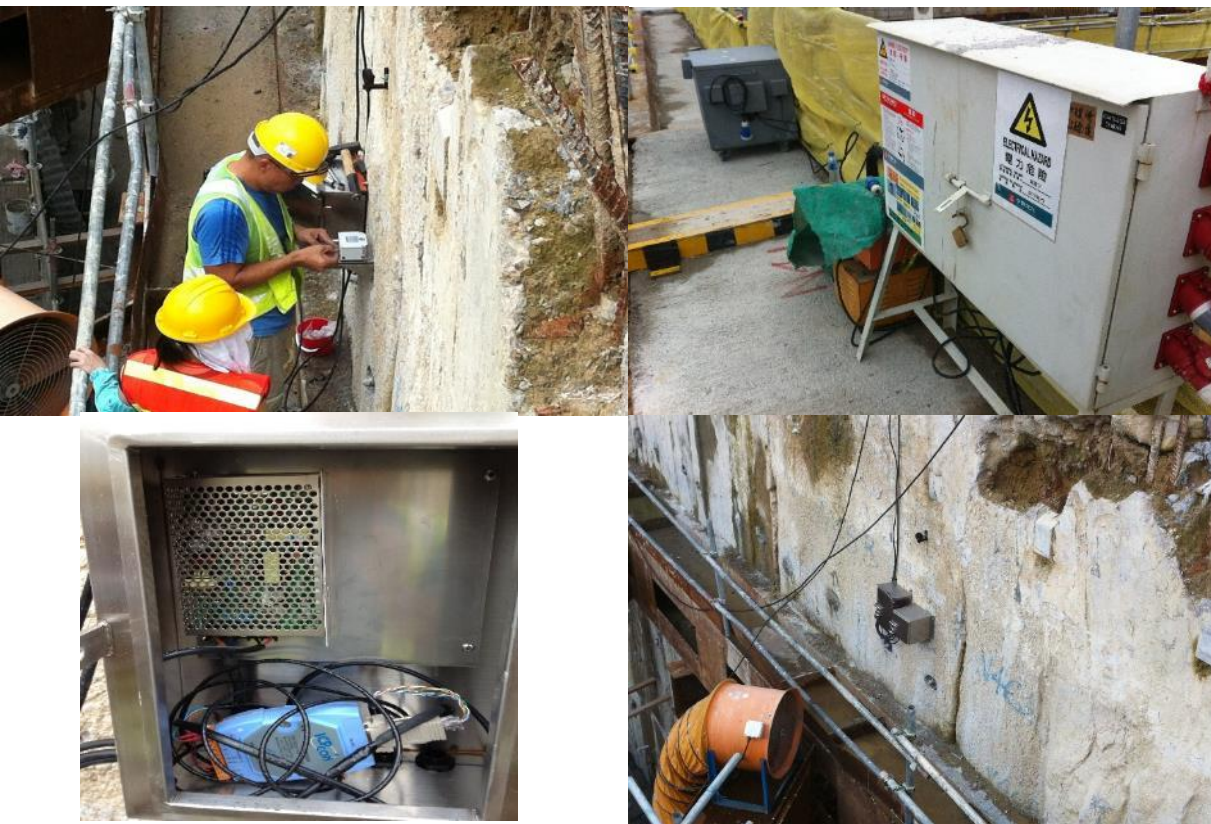


4 Encoder
 $\sigma = 0.203''$ (0.063mgon)

GNSS 参考站



Nivel 监测



Web Interface

Folder: Windows Internet Explorer

http://219.90.114.107/leica_survey/download/leica.asp?planid=8

Google

LEON - Home

Section Summ...

Page

Safety

Translate

This page is in English. Translate it using Google Toolbar?

LEON - Home

ADMS

Settings

Download

My Profile

Alert

Action

Alarm

Logout

Section Summary

Section Data: CWB2

Section Date: 2012/01/10

Time: 07:00 PM

Settlement

Sampling: All

Refresh Data

CWB2 2012/01/10 07:00 PM Height

1X 2X 3X

change site label for all tag
CWB2(ADMS1)Station C
CWB3(ADMS2)Station D
CHT1(ADMS4)Station E

delete

enlarge double text size

Folder: Windows Internet Explorer

http://219.90.114.107/leica_survey/download/leica.asp?planid=8

Google

LEON - Home

Section Summ...

Page

Safety

Translate

This page is in English. Translate it using Google Toolbar?

LEON - Home

ADMS

Settings

Download

My Profile

Alert

Action

Alarm

Logout

Section Summary

Section Data: CWB2

Section Date: 2012/01/10

Time: 07:00 PM

Settlement

Sampling: All

Refresh Data

CWB2 2012/01/10 07:00 PM Height

1X 2X 3X

change site label for all tag
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Section Summary

Section Data: CWB2

Section Date: 2012/01/10

Time: 07:00 PM

Settlement

Sampling: All

Refresh Data

CWB2 2012/01/10 07:00 PM Height

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—— 谢 谢 ——

A decorative graphic at the bottom of the slide consisting of several overlapping triangles pointing upwards. The triangles are in various shades of blue and green, creating a layered, mountain-like effect.