The Status of SSRF Survey and Alignment System

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I. Introduction

II. Design of SSRF survey and alignment system

III. Implementation

Introduction

- Shanghai Synchrotron Radiation Facility

- 3.5GeV


Volga
Ob'
Yenisey
Lake Baikal
Amur
North Pacific Ocean
Caspian Sea
KAZAKHSTAN
RUSSIA
Harbin
Aral Sea
Lake Balkhash
MONGOLIA
Shenyang
JAPAN
NORTH KOREA
SOUTH KOREA
UZBEKISTAN
TURKMENISTAN
KYRGYZSTAN
BEIJING
Tianjin
Ürümqi
Yellow Sea
IRAN
TAJIKISTAN
Huang He
Indian claim
Lanzhou
Zhengzhou
Shanghai
AFGHANISTAN
Xi'an
Nanjing
Philippine Sea
East China Sea
Indus
Wuhan
Chengdu
Chongqing
Chinese line of control
Brahmaputra
Jiang
Chang
PAKISTAN
Taipei
Lhasa
Taiwan
NEPAL
Ganges
Guangzhou
INDIA
BHUTAN
Mekong
Hong Kong S.A.R.
Macau S.A.R.
BANGLADESH
South China Sea
Arabian Sea
VIETNAM
BURMA
LAOS
Hainan Dao
PHILIPPINES
THAILAND
0 300 600 km
0 300 600 mi

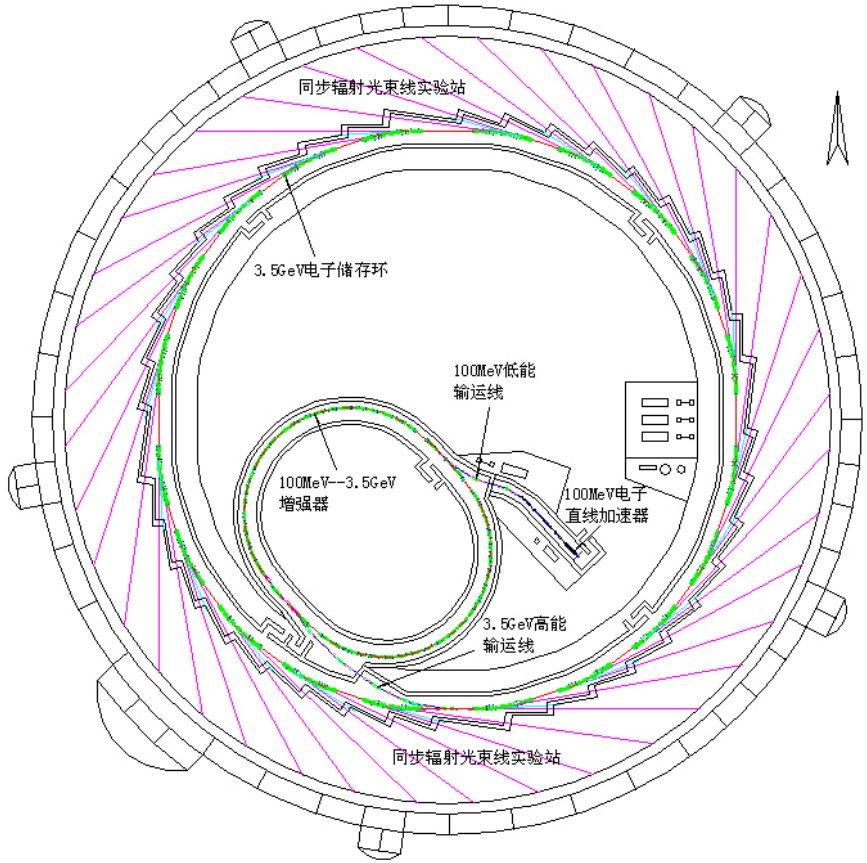
SSRF


N
規劃外環線
Planned Outer-Ring Road
外高橋港區
Wai Gao
Qiao Harbor
長 江
Yangtze River
黃
浦
江
Huangpu River
外高橋保稅區
Wai Gao Qiao
Free Trade Zone
內環線高架
Inner-Ring Road
浦東大道
楊高路
Yanggao
Road
Pudong
Avenue
上海火車站
Shanghai
Railway
Station
上海市政府
Shanghai
Municipal
Government
楊浦大橋
Yang Pu
Bridge
金橋出口加工區
Jin Qiao Export
Processing Zone
張江路
Zhangjiang Road
Planned Subway
Route No. 2
地鐵二號線
成都路高架
Chendu Express Way
陸家嘴金融貿易區
Lu Jia Zui Finance
& Trade Zone
湯臣浦東高爾夫球場
Tomson
Golf Course
Longdong Avenue
龍東大道
南浦大橋
Nan Pu Bridge
上海市張江高科技園區
Shanghai (Z.J.)
Hi-Tech Park
地鐵龍東路站
Longdong Road
Station
地鐵一號線
Subway
Route No.1
虹橋國際機場
Hong Qiao
International Airport
SSRF
規劃浦東國際機場
Planned Pudong
International Airport
徐浦大橋
Xu Pu Bridge

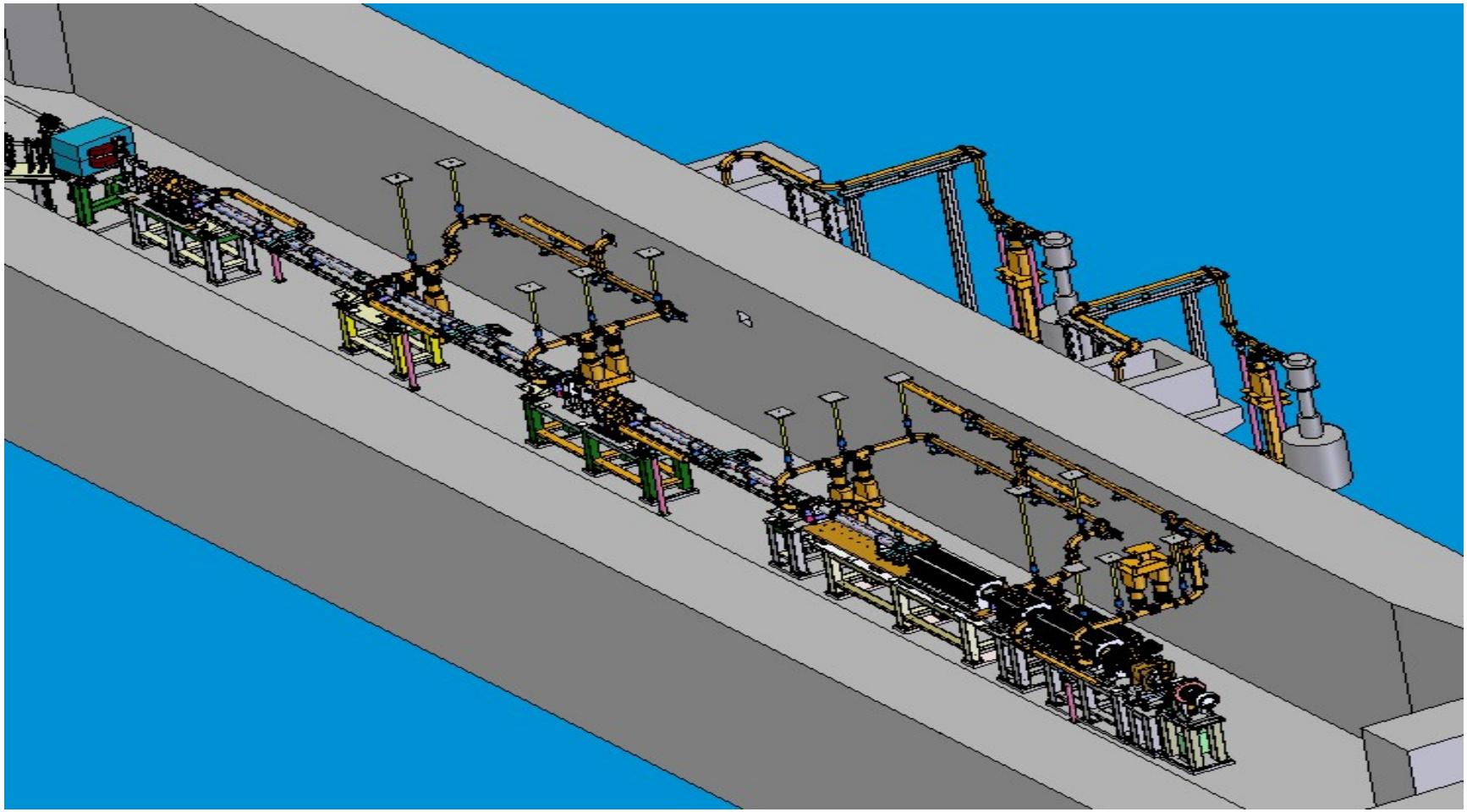
- Alluvion of Yangtze river
- Altitude 4m
- Soft soil, hard rock under 300m
- Under the slab,hundreds of pillar about 48m deep
- Vibration (biggest)

Layout of the SSRF complex

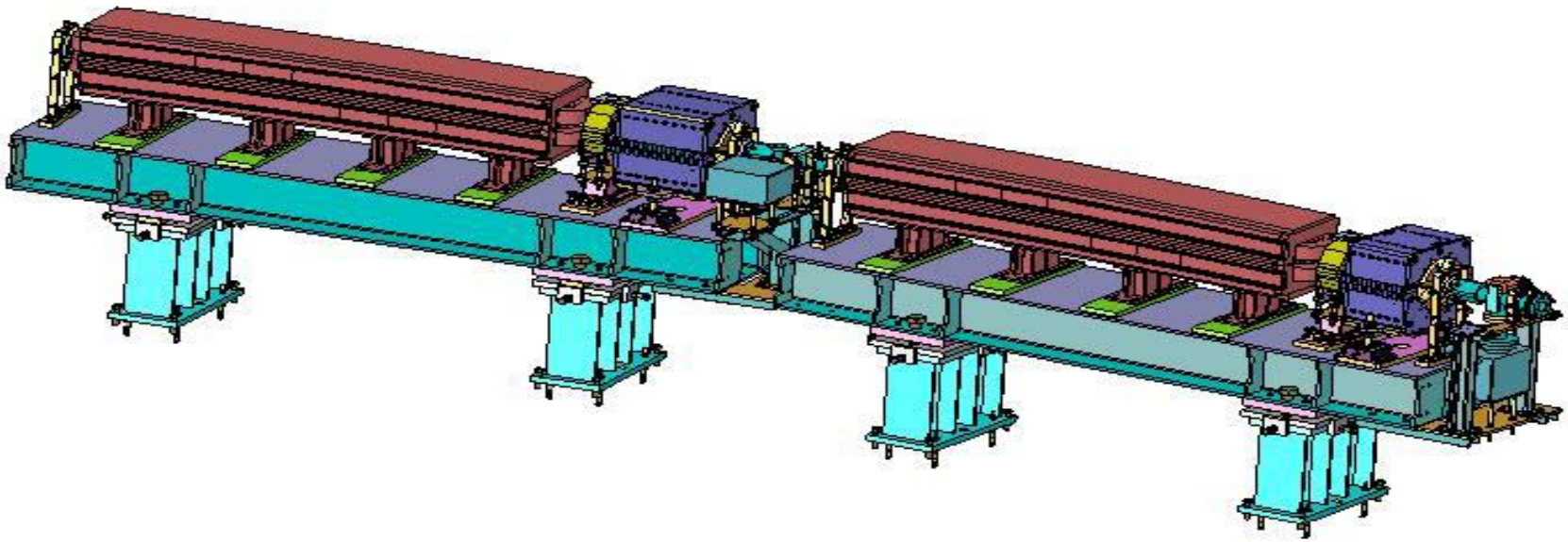
- 100MeV Electron Linac
- 3.5GeV Booster
- 3.5GeV Storage Ring
- 7 Beam Lines and Experimental stations at phase 1



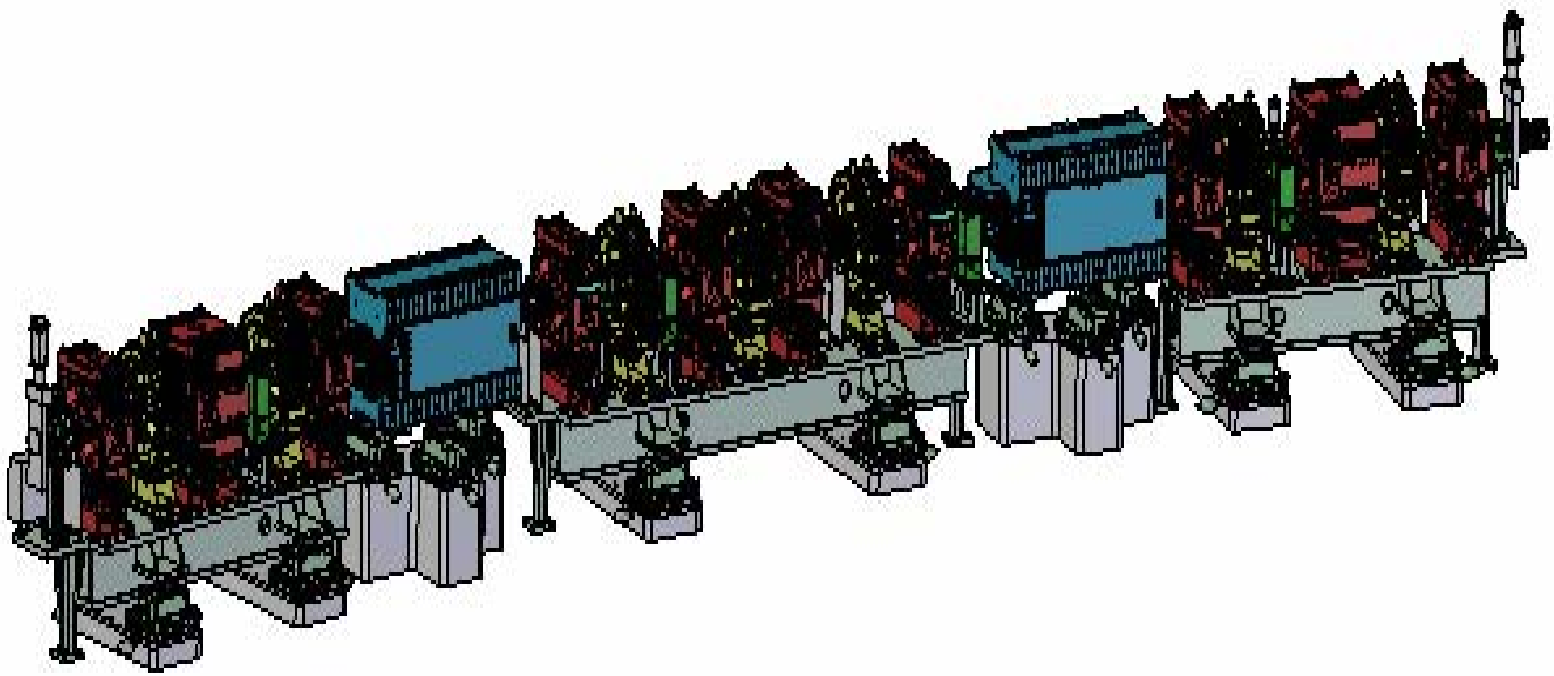
Linac



Standard cell of booster

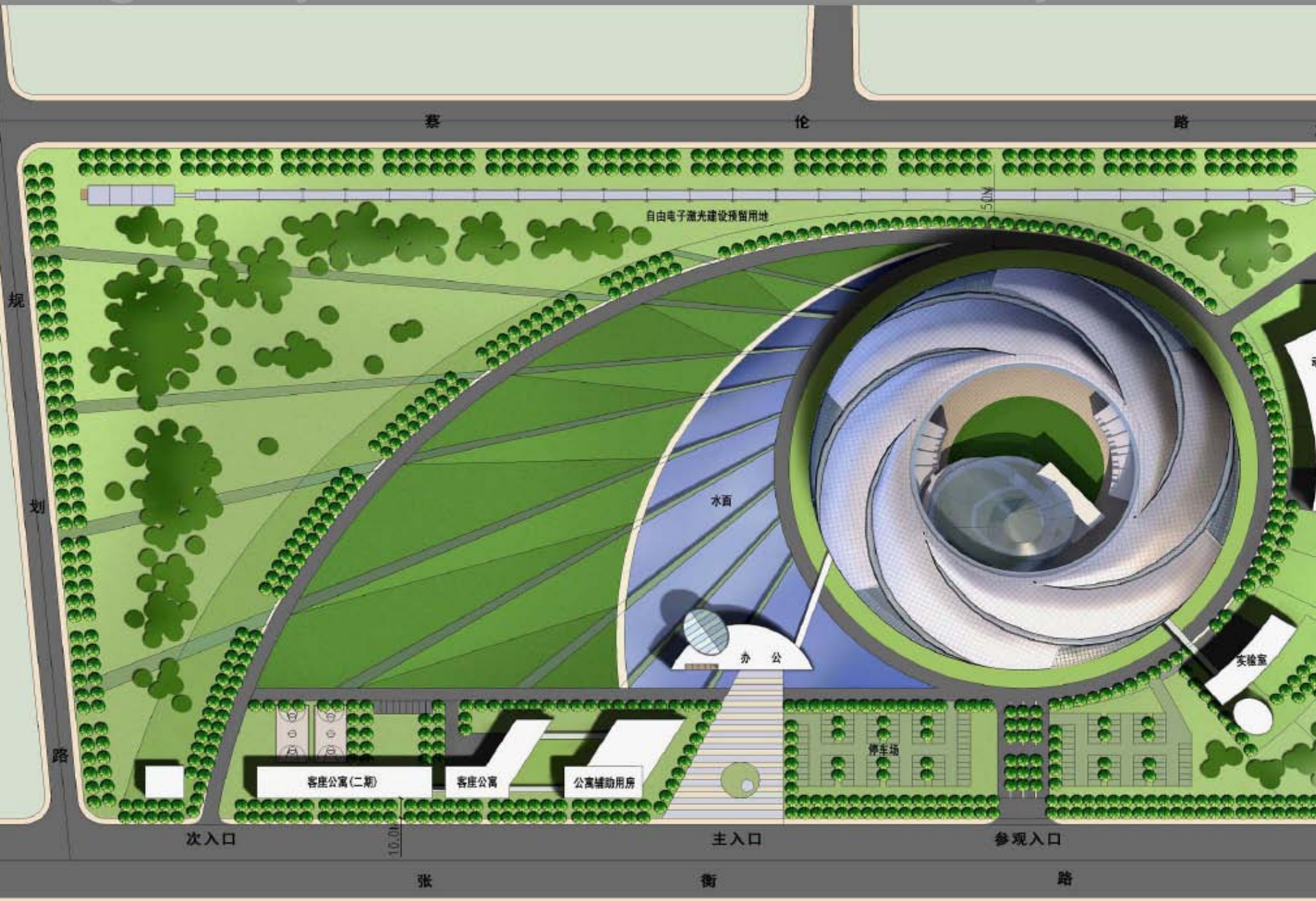


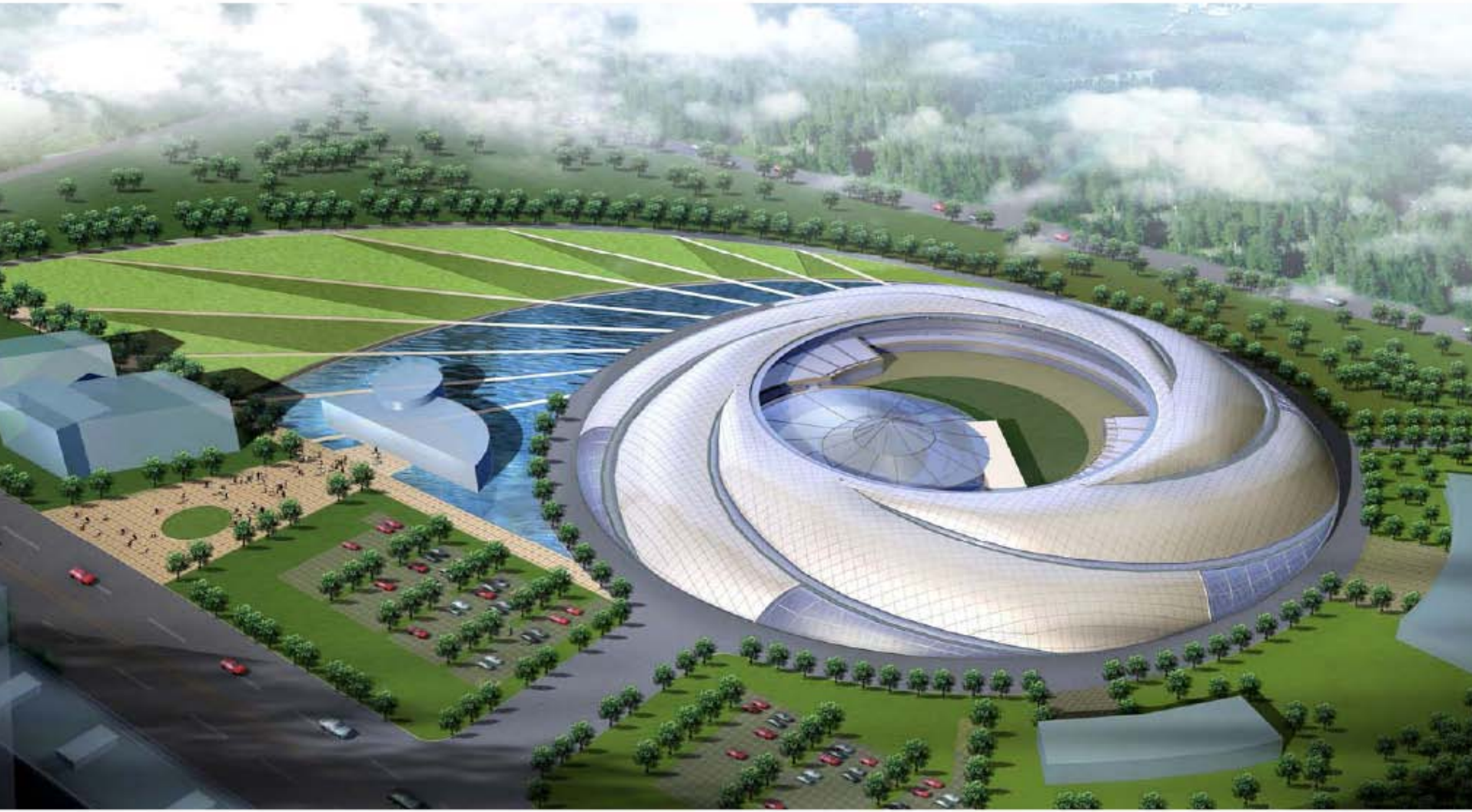
Standard cell B of storage ring



The Status of SSRF(1)

- Building is almost OK


蔡
伦
路
规
划
路
自由电子激光建设预留用地
50M
水面
办 公
实验室
停车场
客座公寓(二期)
客座公寓
公寓辅助用房
10.0M
次入口
主入口
参观入口
张
衡
路



Nautilus


2006/09/24


2006/09/24


2006/09/24

The Status of SSRF(2)

- Test assembly is finished
- Magnet and other hardware is in mass production
- The formal installation in tunnel will begin one month later
- Scheduled to finish on April 2009

The status of survey and alignment

- Design and review is finished
- Non-Standard manufacturing is finished
- Instrument and manpower is in situation
- Through test assembly, alignment design is validated and refined
- The on site control network measurement is going on

PartⅡ Design of SSRF survey and alignment system

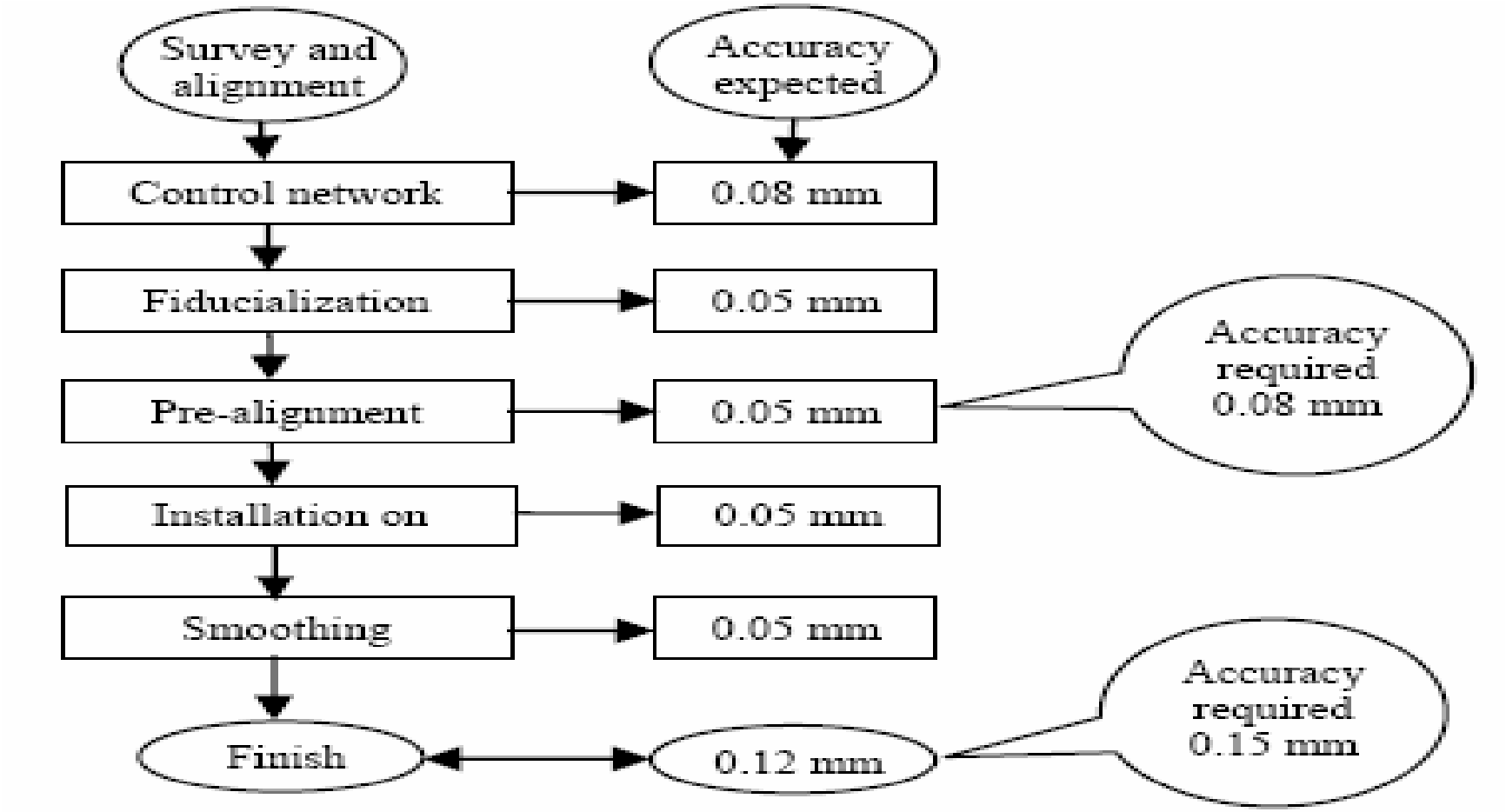
Error Tolerance

- The circumference installation error (storage ring):10mm,1~2mm expected
- The measurement accuracy of the circumference :<1mm
- Sub-millimeter for magnets

Storage Ring Magnet Tolerance in girder

	Quadruple	Sixtupole	Corrector
ΔX(mm)	0.08	0.08	0.2
ΔY(mm)	0.08	0.08	0.2
ΔZ(mm)	0.3	0.3	0.3
ΔθX(mrad)	0.2	0.3	0.5
ΔθY(mrad)	0.2	0.3	0.5
ΔθZ(mrad)	0.2	0.2	0.2

Survey and Alignment Procedures

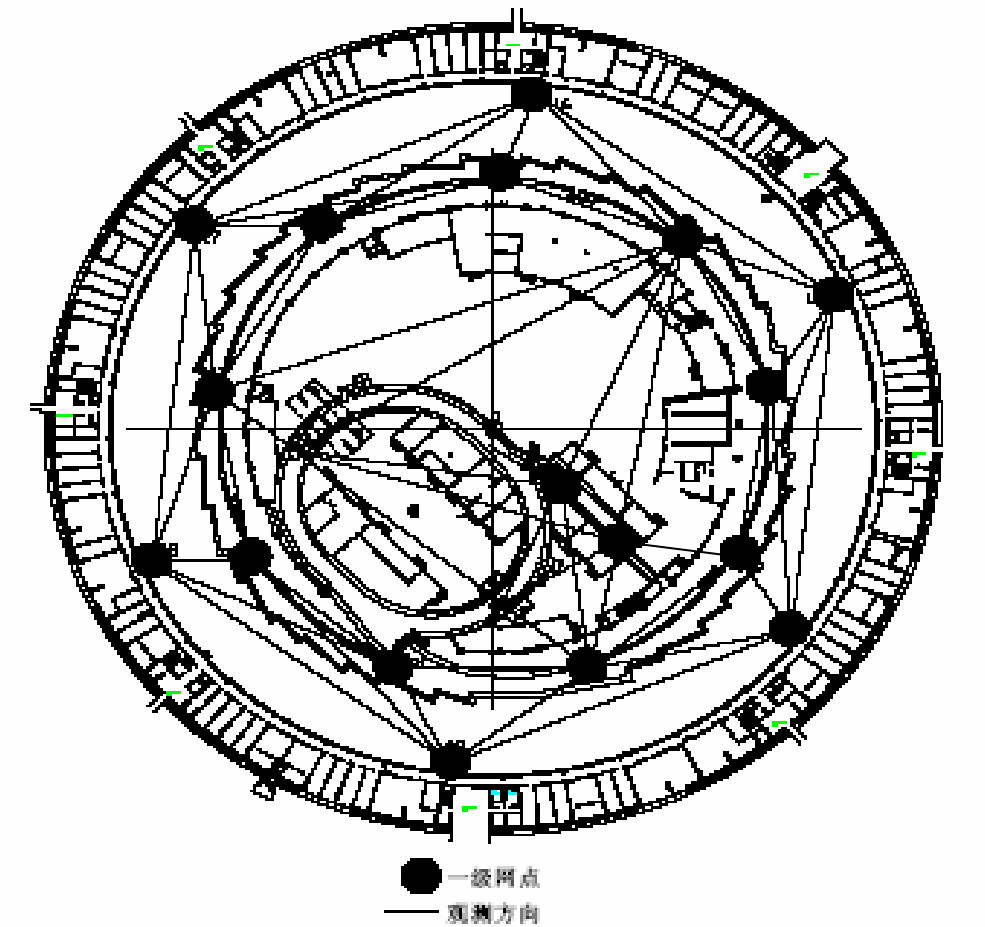


Circumference

- Higher accuracy control network (installation error)

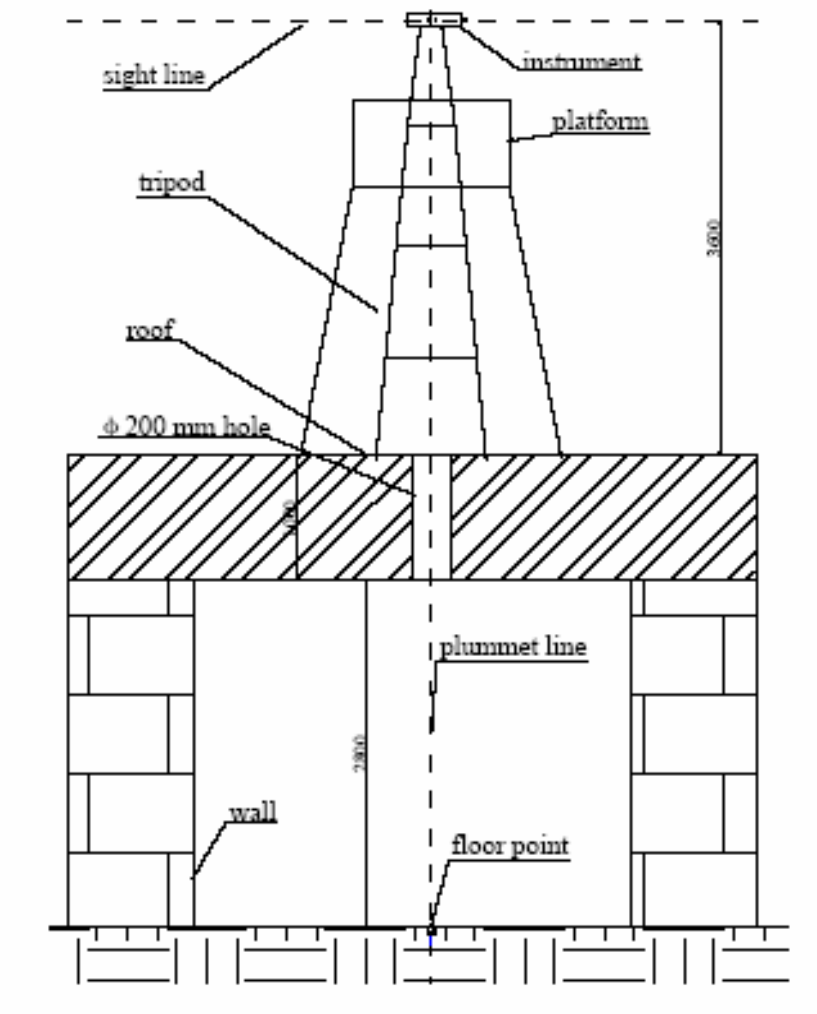
- Laser tracker (IFM, measurement error)

1.Global Control Network



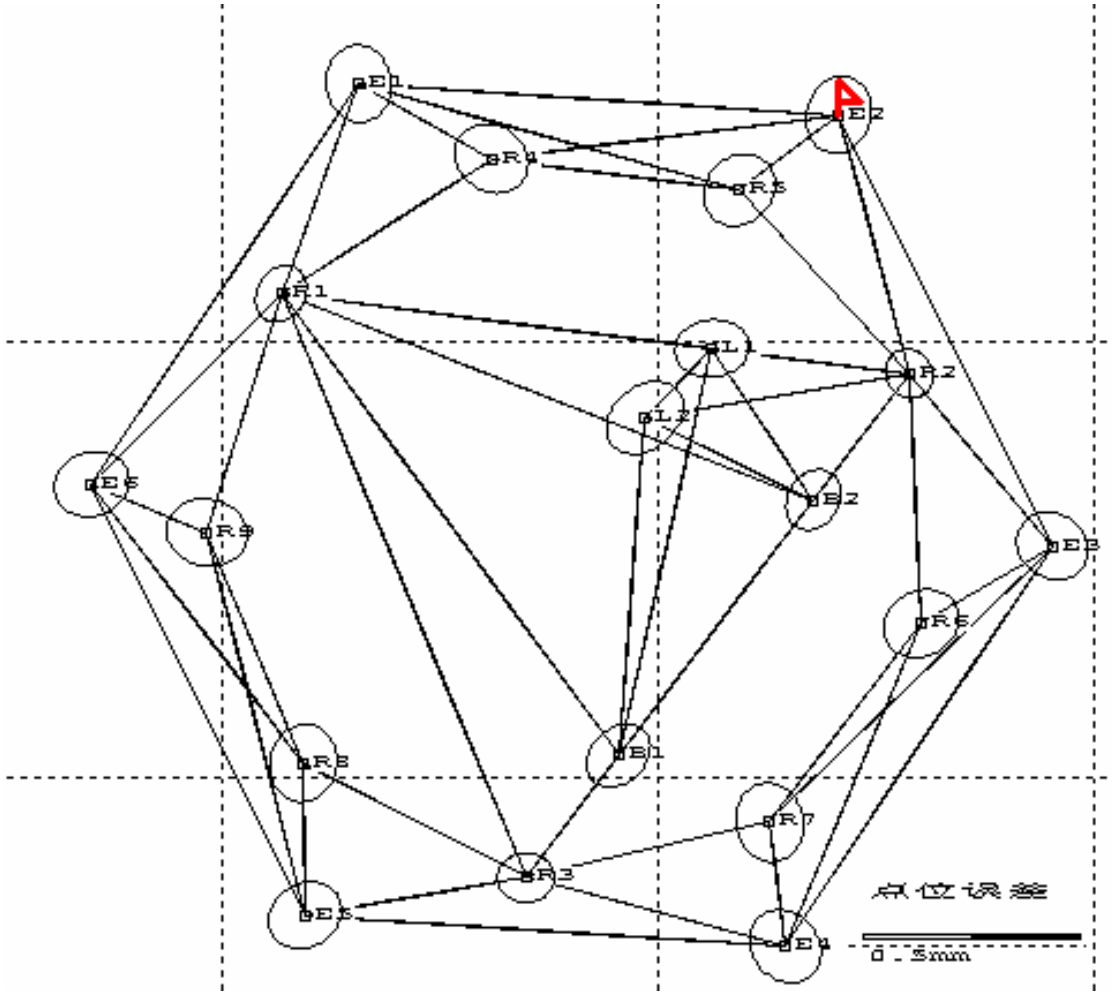
- 19 points
- Total Station
- NL

Survey Sketch for Global Network

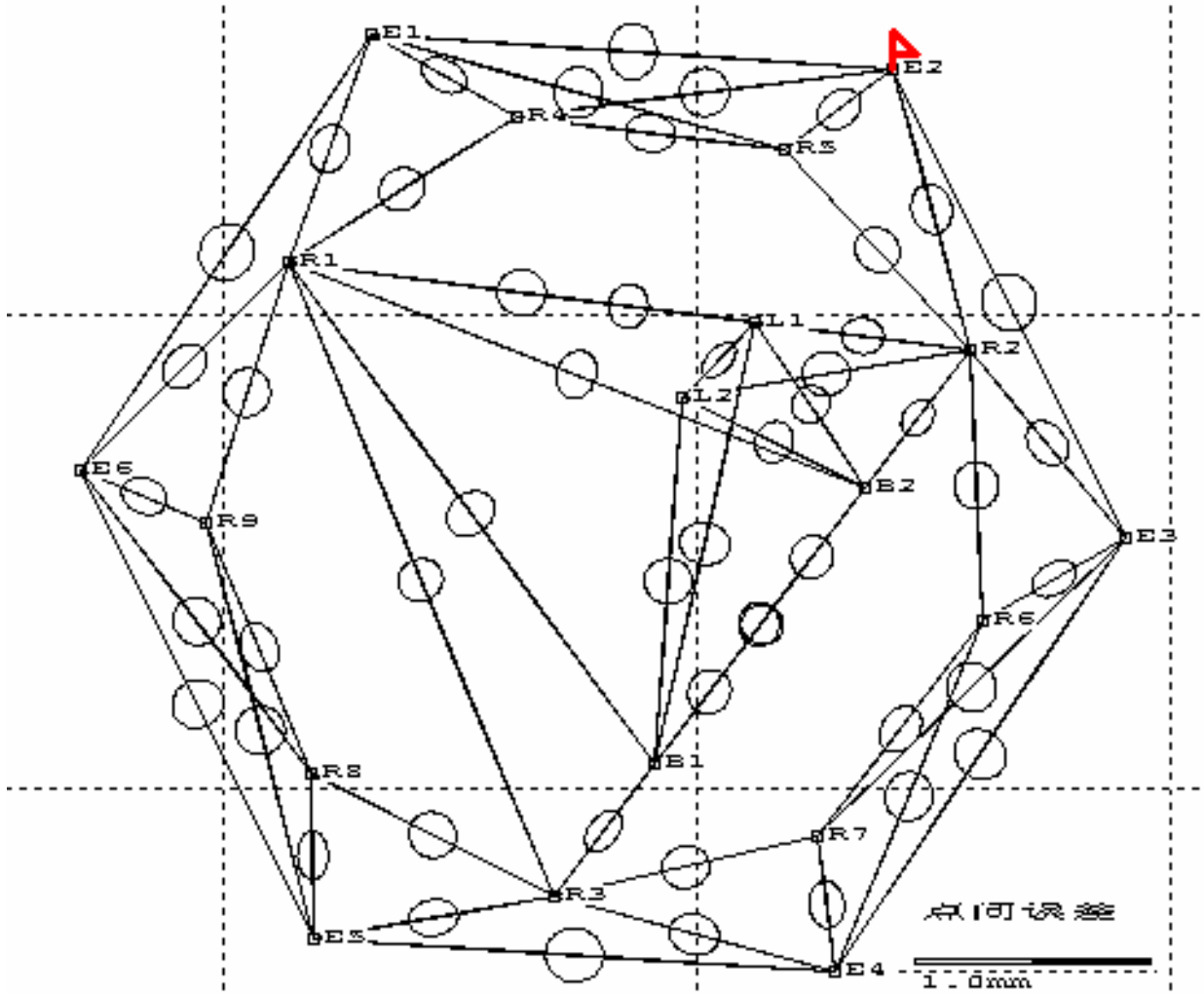


- 7.4m
- Observer and instrument separated

Absolute error ellipse

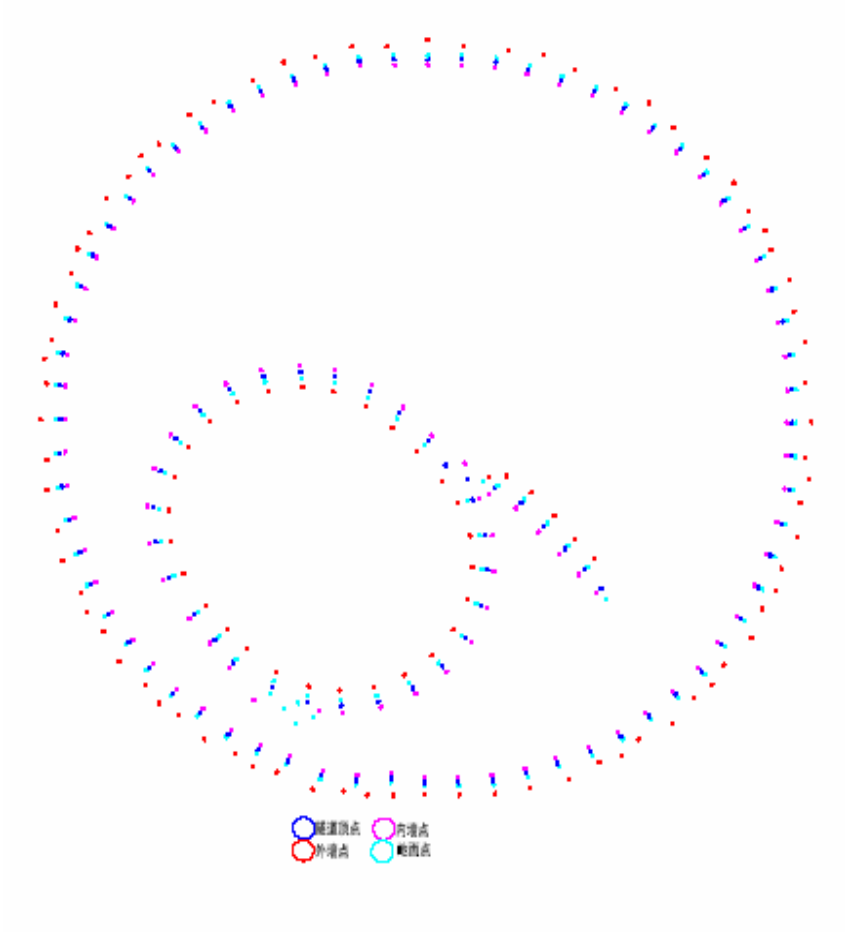


Relative error ellipse

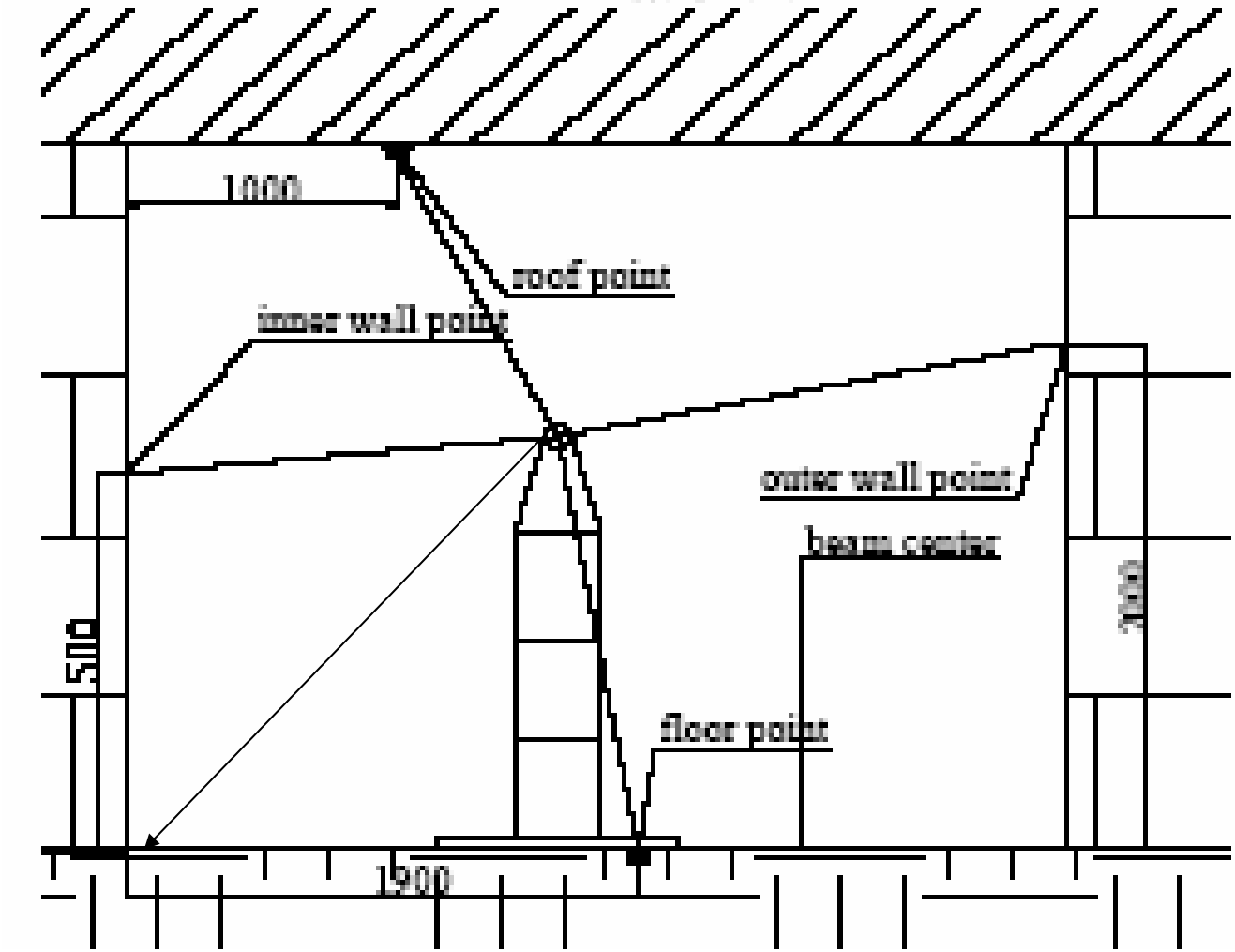


2.Local Control Network

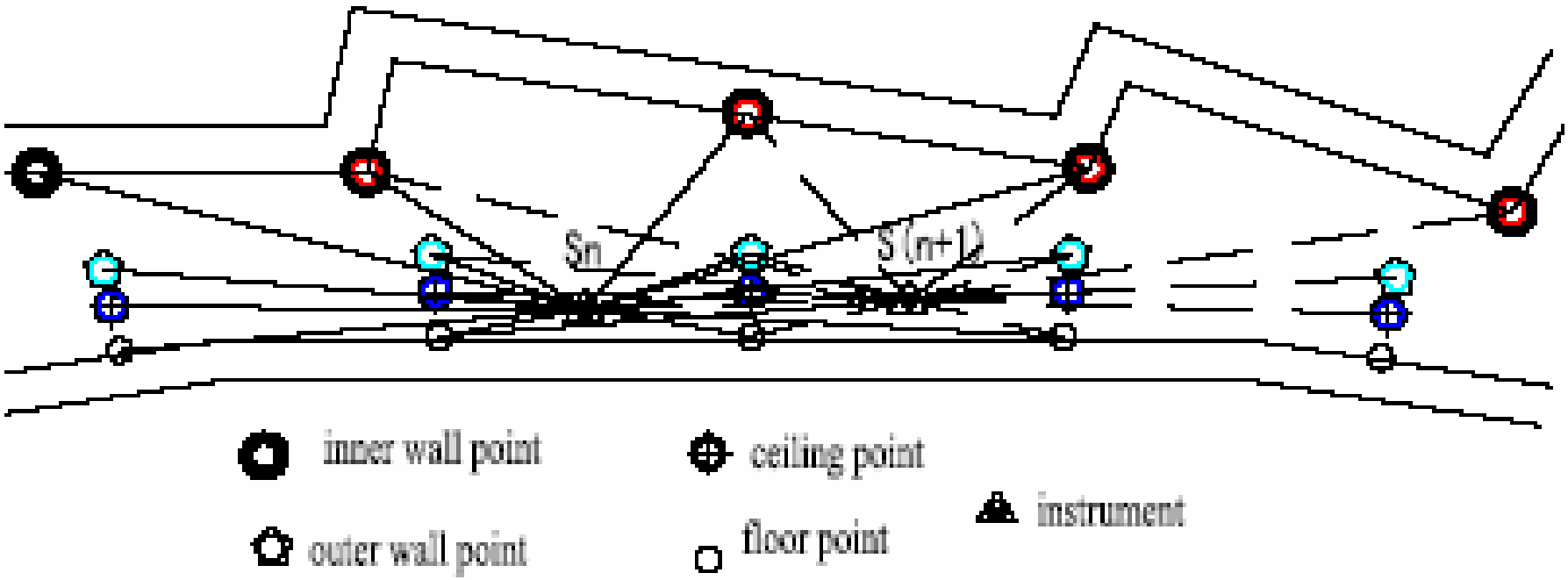
- About 700 monuments (experimental hall included)



Cross section view



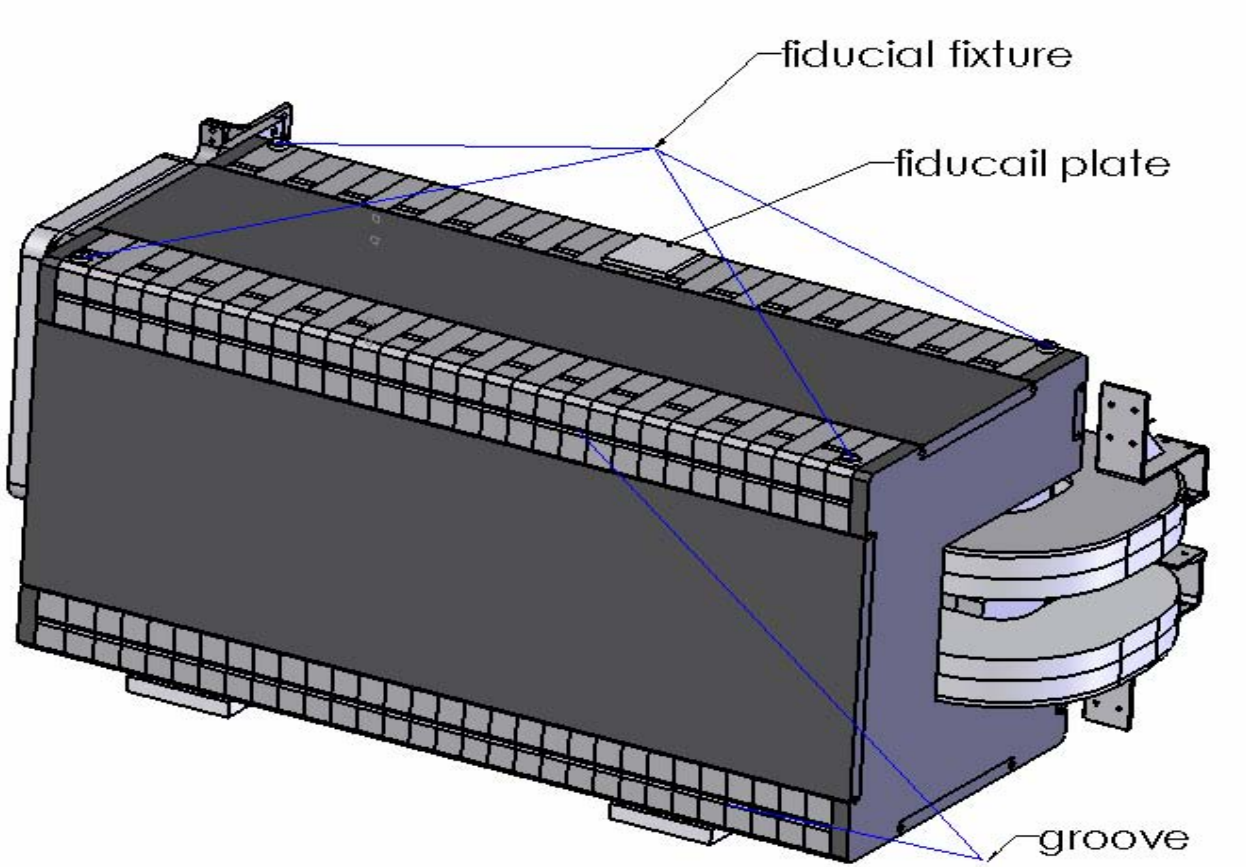
Top view


Sn
S (n+1)
inner wall point
ceiling point
instrument
outer wall point
floor point

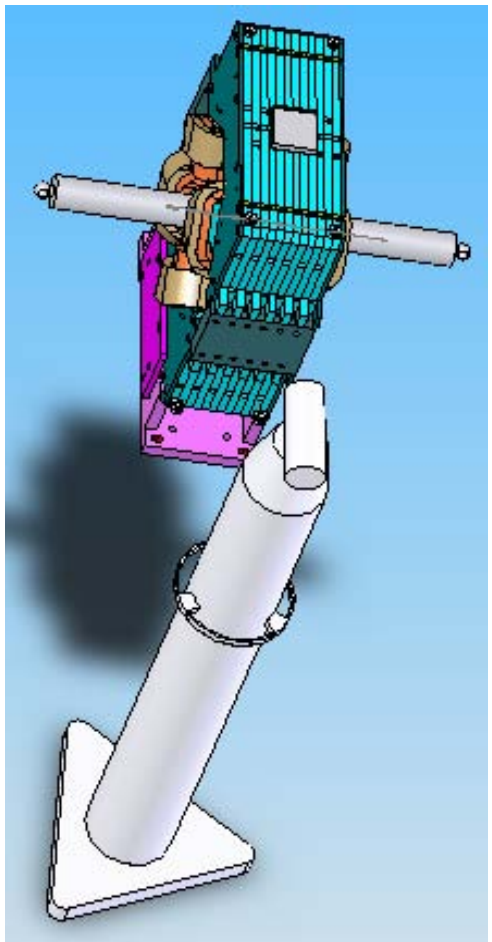
Fiducialization

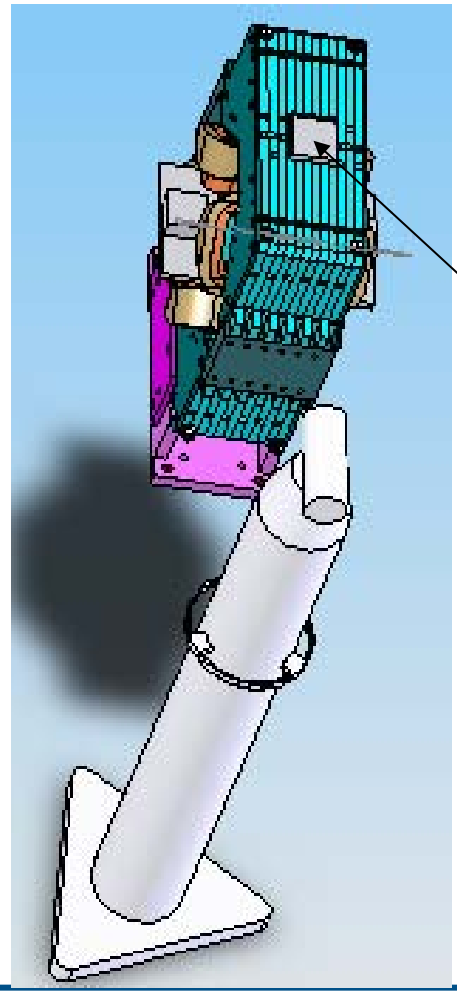
- Done by our staff
- By laser tracker or articulated arm

Fiducials



Use coil from magnet measurement

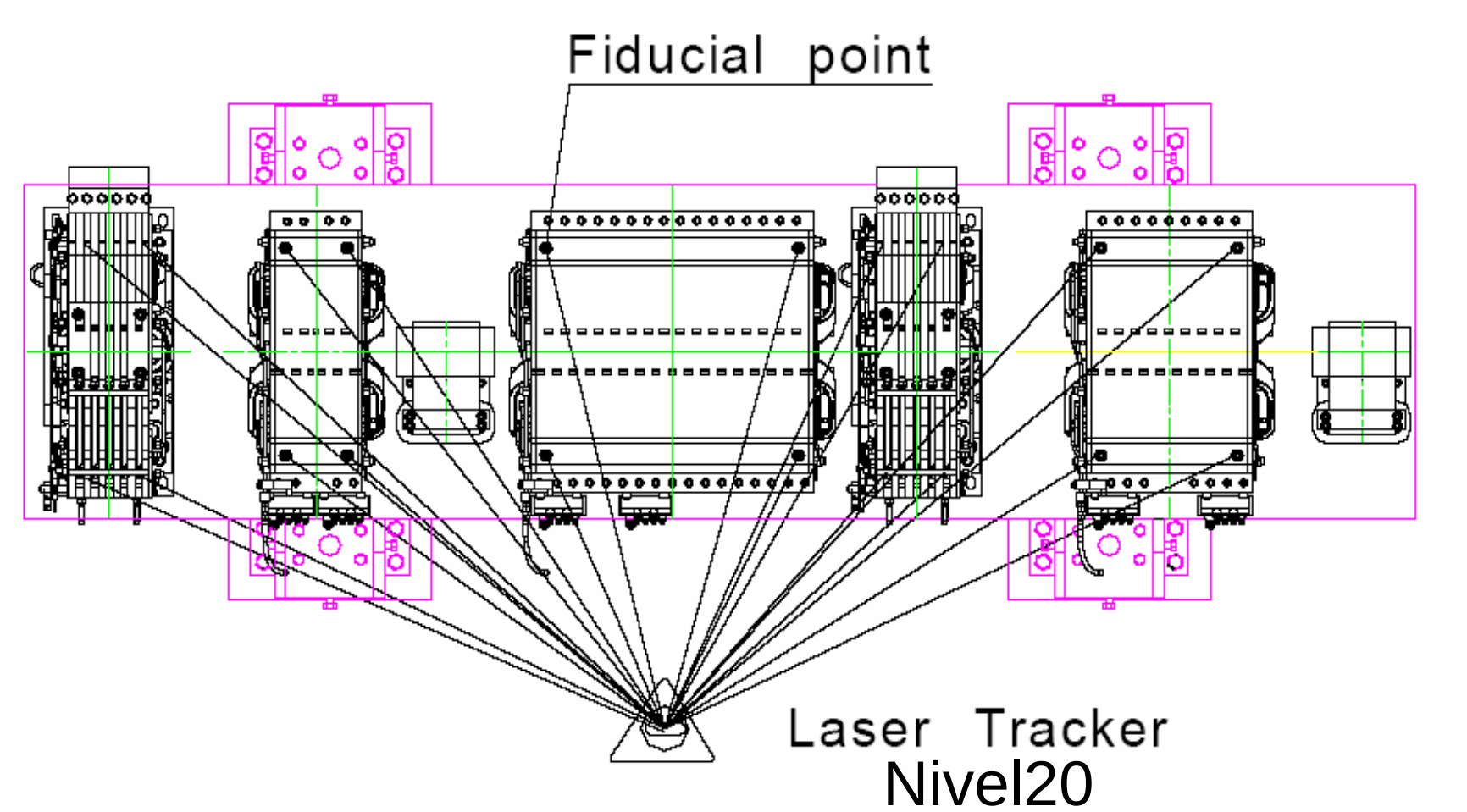




- About 700 magnets
- Huge job

Nivel20

Pre-alignment



Installation on site

- Mark beam centre-line and magnet entrance and exit
- Setting out cement frusta (1~2mm accuracy).
- Align girders
- Dismantle the upper part of all the magnets, align vacuum chamber. Then restore.
- Bending magnets are put into its position and aligned.

HLS

- HLS will be constructed
- Phase 1:about 20~40 sensors for monitoring the deformation of floor
- Phase 2:each girder will have sensors for monitoring

PartIII Implementation

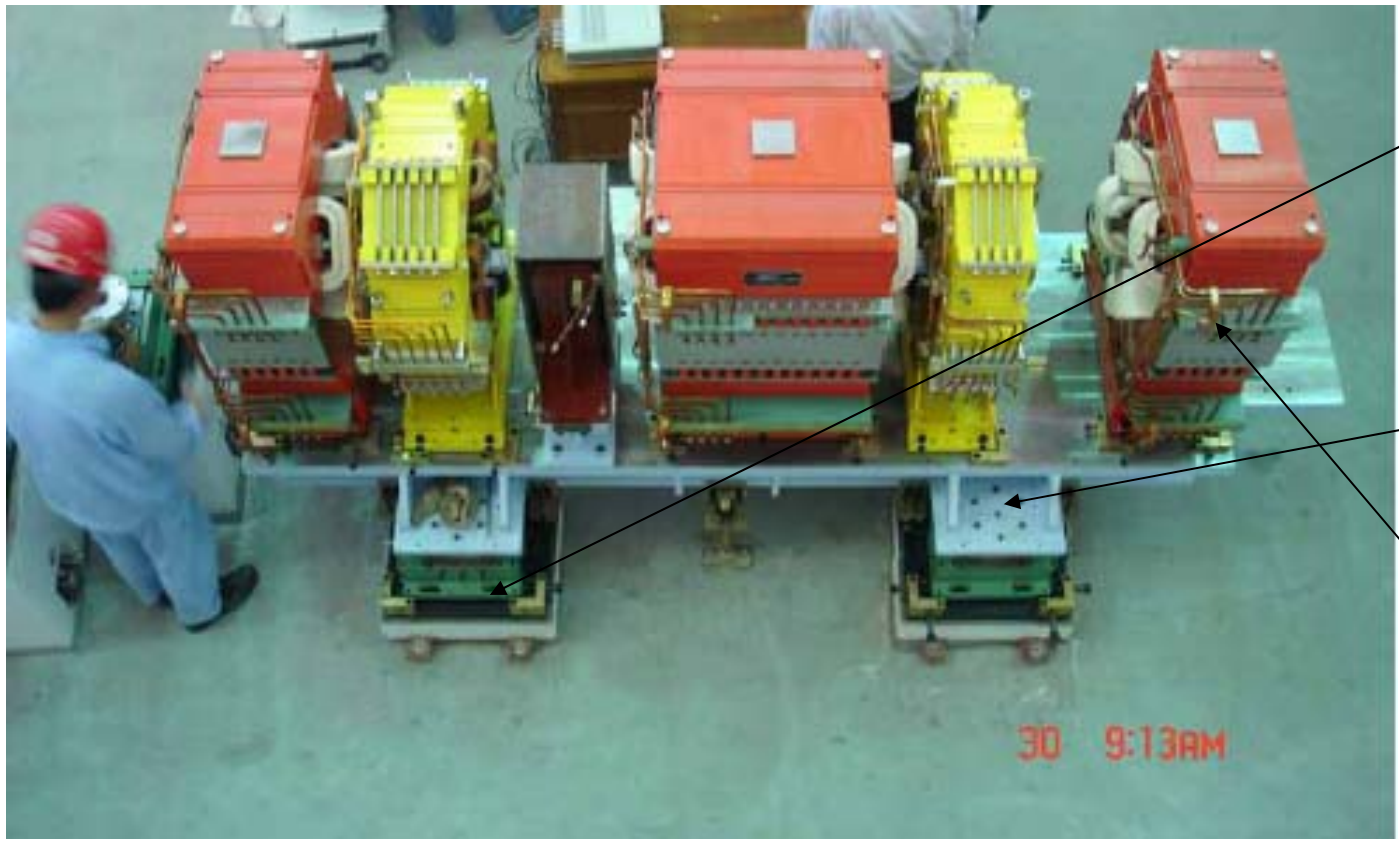
Work have done

- Test assembly
- Fiducial manufacture
- Instrument purchasing

Test Assembly

- Control network
- Pre-alignment
- Installation on site

Work flow



setting concrete plate

setting girder

alignment magnet


9:01AM


30 8:57AM

Booster


1 10:49AM


12 2:02PM

Questions founded

1. Operator of laser tracker should be trained and procedure should be regulated
2. More reference holes should be preserved on girder
3. Floor reference points should avoid the position of cable bridge

Manufacturing

Marble for magnet center plane determination

Manufacturing

Several fixtures

Instrumentation

- Total Station+NL
- NA3003,NA2
- Laser tracker LTD500
- Laser tracker LTD640 (newly purchased)
- Articulated arm from Faro (newly purchased)
- Interferometer from Renishaw (newly purchased)

Manpower

- 3 engineers of SSRF (2 new coming in July 2006)
- 3 engineers from installation company
- average age 30

Bury network points

Floor fixtures

Wall fixtures

Work is going on

- Level measurement for floor and monument

- Horizontal control network measurement

Instrument Support (1)

For experimental hall (3 points)

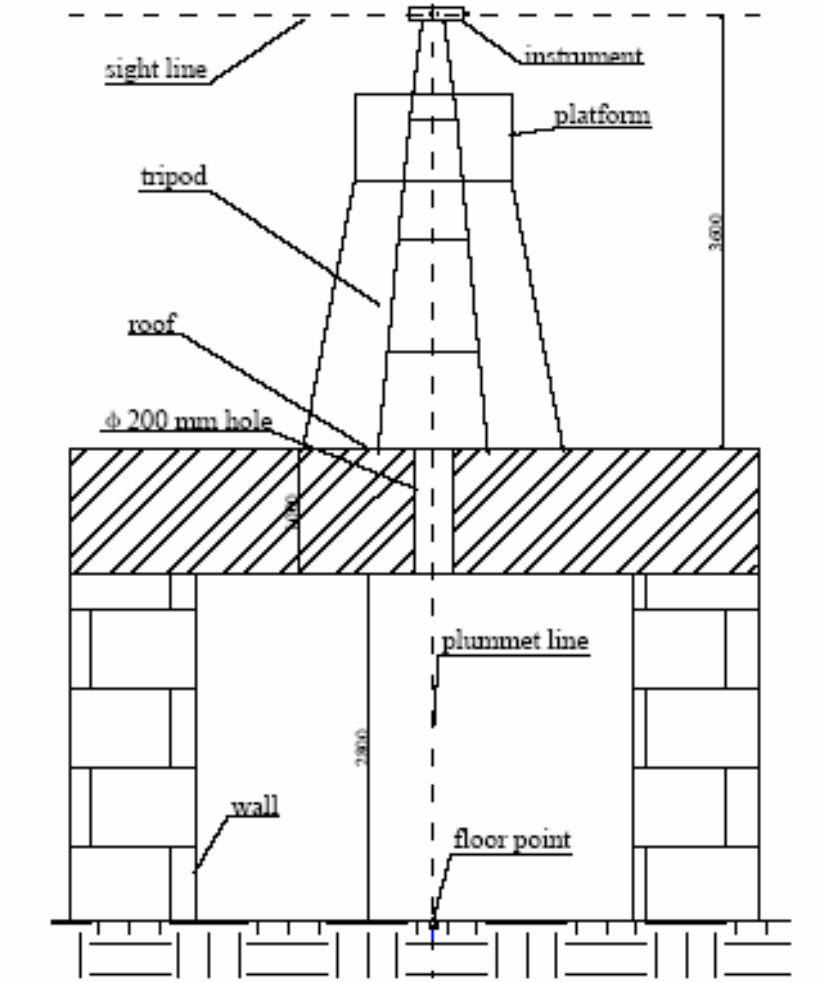
Bridge of city and accelerator coordinate system

Instrument Support (2)

for Linac
and
Booster
(4 points)

6.7m roof

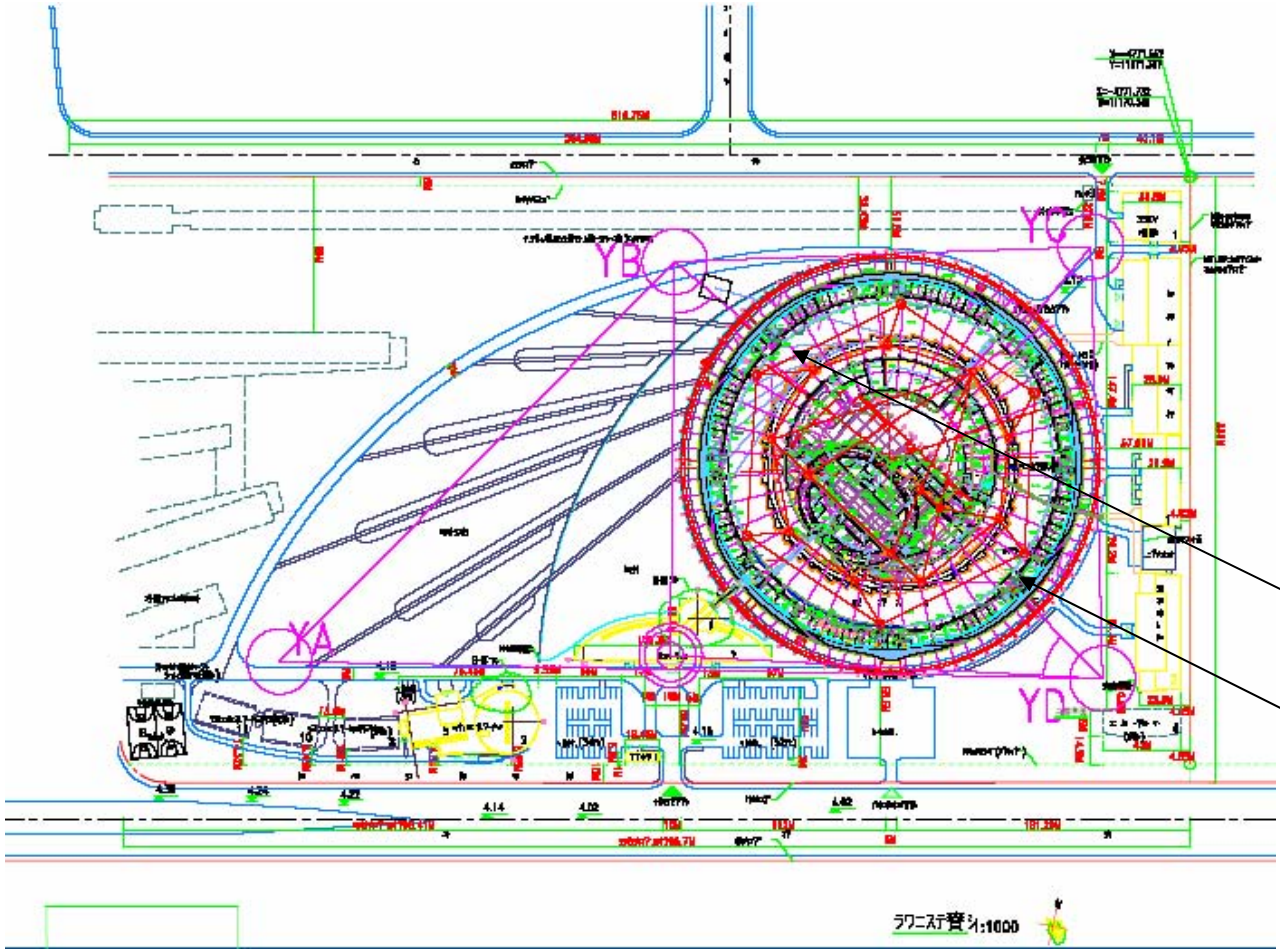
Instrument Support (3)



For SR (9 points)

Site Survey Pillar

5 points



YC、YD changed with the construction, can't be used

Hall1

Hall3

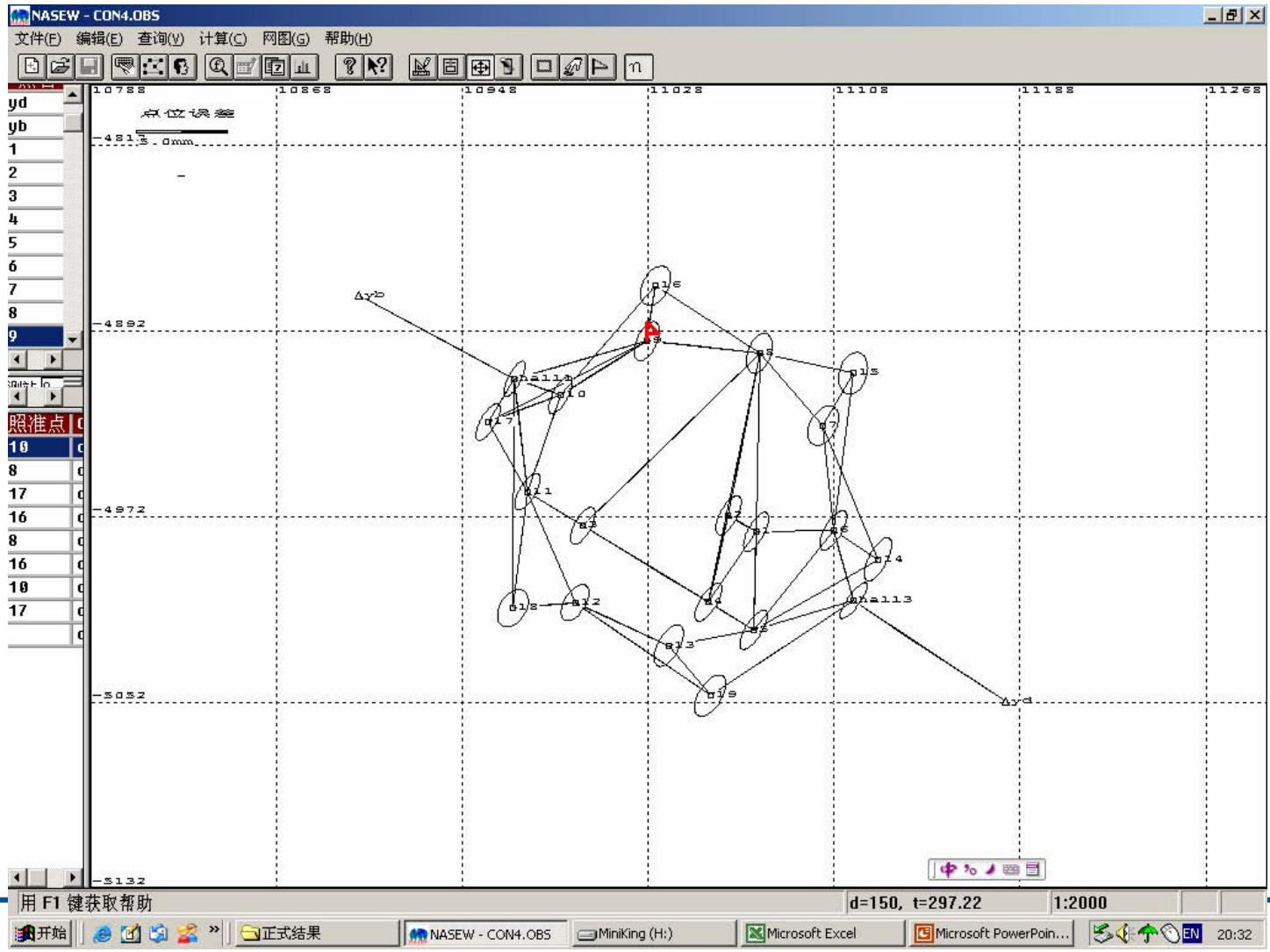
- 2 groups
- Total Station TDM5005，TDA5005
- NL（2）

- Mainly distance measurement
- Few angle measurement

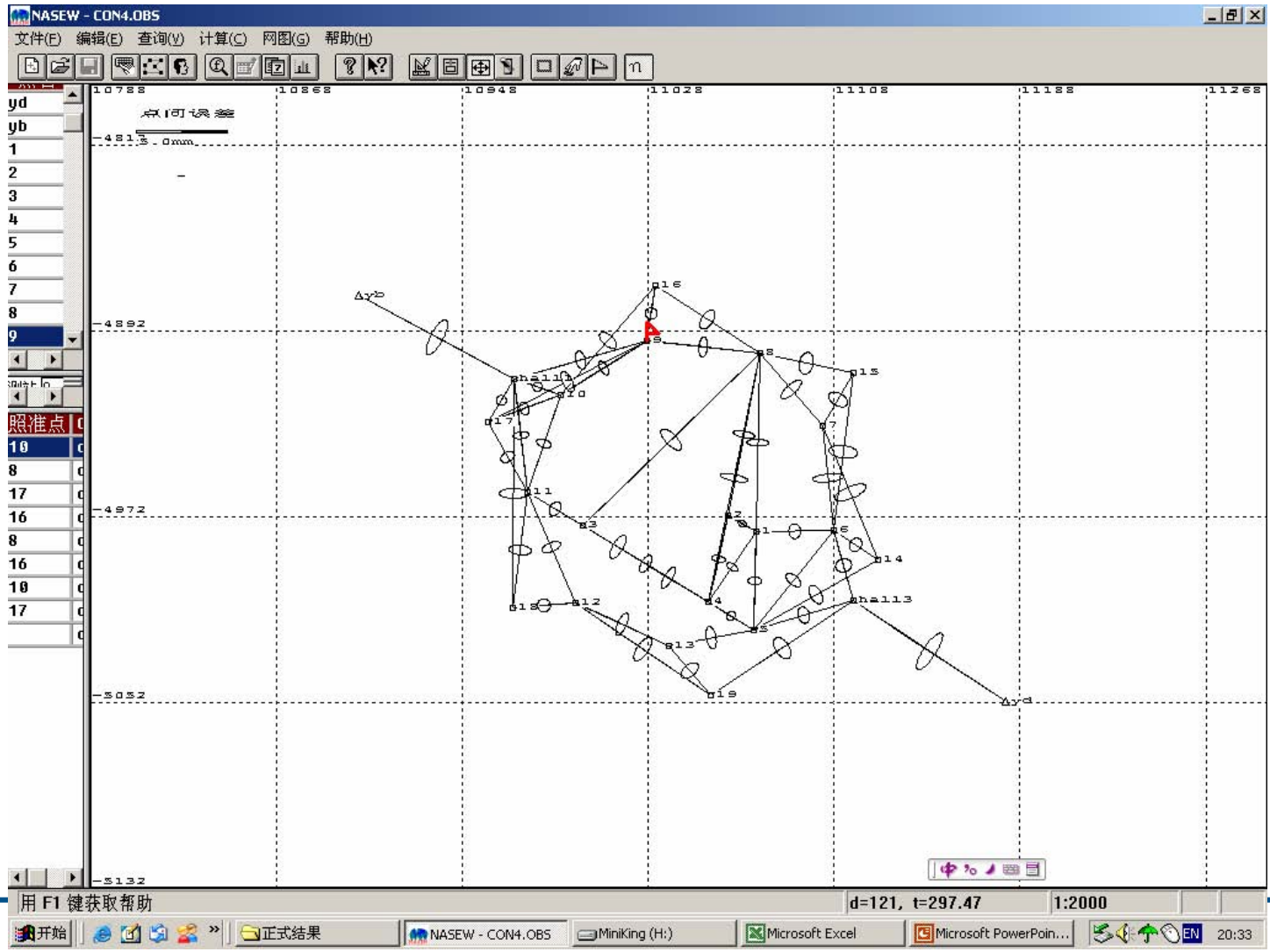
Adjustment

- “Survey” and NASEW95
- YB、YD known points

Absolute point error



Relative point error



Comments on the result

- Absolute point error(4mm),relative point error(1~2mm)
- Can only be used for coarse setting out

Substituted supports

Will be OK this week

Sighting port

To be contiuned

- It’s only the beginning
- Real hard work is coming in recent days and will last for 1.5 years

Conclusion

- Mainly introduces the design
- Little on the actual work
  - Busy for the measurement
  - Give up the hope to attend this workshop

Acknowledgement

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Thank you for your attention
谢谢！