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1. INTRODUCTION

Lao People's Democratic Republic (Lao PDR) bordering Cambodia, Myanmar, Thailand, Vietnam and the People's Republic of China. Situation in middle of the Greater Mekong Sub-region (GMS), some of the world's rapidly developing economies.

The aim needs to be transforming the land-locked to land-linked country. Lao PDR located at middle of economic and transport corridors of GMS, it has the opportunity to challenge the advantage from all activities along the corridors, while the tough joined with cross border of population movement, goods and services being managed efficiently.

This report described about procedure and technique for improvement and maintenance NR.13North from Sikeuth Junction and ends at Phonhong in Vientiane Province. The Project involved the improvement of two sections of NR13N, with total length of 58Km, comprising the upgrading from 2 to 4 laned of the roadway from Km12 to Km 31 (Bandong) and rehabilitating the two-lanes section from km31 to Km 70 (Ban Dong to Phonhong). Lao Transport Engineering Consultant (LTEC) has carried topographical Survey and survey teams mobilised to the site project on 29 July 2017 and the survey works completed on 29 September 2017.

2. Technical requirement.

According with project requirement, LTEC should be design 2 options As option1 is Asphalt concrete and option2 is Portland cement concrete. As Department of Roads (MPWT) assigned The Asian Highway Standard is basic uses in Survey -Design for this project are as following:

2.1 Width of Alignment.

(1) Section1: Sikeuth Junction (Km 0) – Ban Songpeuay (Km 19+400)

- 4 Lanes : $3.50\text{m} \times 4 = 14.00 \text{ m}$
- Shoulder : $1.35 \text{ m} \times 2 = 2.70 \text{ m}$
- Edge Shoulder : $0.35 \text{ m} \times 2 = 0.70 \text{ m}$
- Median Barrier Curb : 2.60 m
- Side Walk : $1.50 \text{ m} \times 2 = 3.00 \text{ m}$
- Total Width: 23.00 m

(2) Section2: Ban Songpeuay (Km 19+400)– Phonhong (Km 56+377)

- 2 Lanes : $3.50\text{m} \times 2 = 7.00 \text{ m}$
- Bike Lane : $2.4 \text{ m} \times 2 = 4.80 \text{ m}$

- Edge Shoulder : $0.35 \text{ m} \times 2 = 0.70 \text{ m}$
- Side Walk : $1.50 \text{ m} \times 2 = 3.00 \text{ m}$
- Painted Median = 0.50 m
- Total Width: 16.00 m

For the Road through community should be arranged Bus Bay, Roadside Parking at conditional and suitable place as Market, Official Area, Temple, School, Hospital etc.

3. Survey Work Data Collection.

3.1 Topographical Survey

Since, the survey work of this project was survey for design and improvement existing road as all alignments and level were interrelated permanent constructions already. Topographic Survey Works were conducted as following:

3.1.1 Traverses

Traverse should be arranged ongoing as net system along the road and use this Traverse was base line for all works of this project are following:

- 1) Traverse conducted as closed traverse by front-back method for rechecking with start point.
- 2) Coordinate (N, E) and level (L) transferred BM from National Geographic Department requirement or from old data BM point construction near our project.
- 3) Permanent BM should be used concrete column size $10\text{cm} \times 10\text{cm}$ and 40cm long and poured concrete for fixing the foundation.
- 4) Permanent BM used for checking on next step by buried both of BM each 2Km . Arrangement on safety zone expected that BM will not damage from construction. Cap of BM far from ground 5 cm and buried wood column near BM 1m high and paint red color on cap for easy looking.
- 5) Detail of traverse should be used survey standard 2 level to be permitted tolerance as following:
 - Angle Tolerance $d\alpha \leq 10\sqrt{n}$ (s), n = point of total station setting
 - Distance Tolerance $dD=1/10000$ (mm)

3.1.2 Leveling survey

The Leveling to BM, Traverse and profile points in center line should be conducted by front- back method for checking in start point, must be tolerance as $dL \leq 6\sqrt{D}$ (mm).

D: Length of Level. Tolerance for leveling of cross section and other level are not more than 2mm .

3.1.3 Detail collection for plan drawing

This work consisted detail collection for performance size, shape of existing road and environments along the road including underground setting system as water pipes, electrical wires and telephone lines as well. Width of conditional detail collection should be survey not more than 30 m each side from road center line, distance from levels points along road profile in ordinary condition not more than 10m. In case of changed soil and changing structures had been collected by the real situation.

3.1.4 Obstacles survey collection

The consultant must be measurement and recorded the details of building, house, constructions and setting system along the road including underground system (Telephone lines, water pipes) obstruction to be demolition on construction time for reporting to Project leader.

3.1.5 Measurement and Station marks.

Surveyor should be conducted distance measurement along road center line by measuring tape (m unit) and marked points along road center line every 25 m long by hammered nail with beer lid and sprayed white color around them, color marked with station point every 100 m and every 500 m which wrote (STA) on trees along road or sprayed on the wall or other condition. When we encountered the electric poles, pipes or bridges that should marked (STA) point on electric poles, pipes or both sides of bridge with real STA point for comfortable to site visit from engineer of Road- Bridge Department.

3.2 Observe Existing Converts and drainage system

- Rechecking amount of pipes on static table compared with exactly pipes, location, type of pipes, number of pipes, length, width, pipe status with circumstance recording for report.
- Observation drainage condition, ditch or natural gully which clogged up or demolished or new delved.
- Asking information about level of flood which had deluge problem after that measured depth comparing with road existing level, observation about drainage flowed across the road to have sufficient or insufficient pipes in the present whether some location had necessary to enlarge pipes adjunct.

As for design traffic control system as signs, lines and symbols according with Ministry of Public Works and Transport assignment.

3.3 Labor Safety

NR 13 North Road from Sikeuth Junction to Phonhong was crowded houses, crowded traffic in peak hour, driver used high speed. For damage accident avoiding, the survey team should be aware to protect our staff at site area. The staff should have the safety shirts or hat with reflection light, setting the limited speed sign (20Km/h), barrier for worker area or human waving if necessary.

4. Location Map of the Project.



5. TOPOGRAPHICAL SURVEY.

5.1 Traverse

Traversing was carried out starting from known Bench Mark monument and allocated to all intermediate Bench Marks by using Theodolite Total Station in measurement of traverse line, and BM as permanent concrete monuments are established reference points and the interval is according to the TOR.

5.2 Coordinate System

5.2.1 Work Procedure

The objective of coordinate was carried out by Global Positioning System (GPS) satellite signal amount 04 pair (08 points) along NR 13 North as for base point of NR 13 North improvement and maintenance project (Sikeuth Junction-Phonhong).

Horizontal Datum, construction survey and base station for this project had transferred from Nongteng and Kaoliew-Sangthong District (Lao National Geodetic Datum 1997).

The detail parameters at Nongteng No. 00001 are as follows:

- Spheroid: Krassousky ($a= 6378245.000$, $b= 6356863.018$)
- Flattening: $f=(a-b)/a$, $1/f= 1:298.3$
- Origin Station: Vientiane, Nongteng (GPS 36201)

The Transformation parameter used to convert Lao National Geodetic Datum 1997 to World Geographic System (WGS84) as below:

$$\Delta x = +46.012 \text{ m}$$

$$\Delta y = -127.108 \text{ m}$$

$$\Delta z = -38.131 \text{ m}$$

Remark The Transformation parameter used to convert WGS84 to Lao National Geodetic Datum 1997 just changed the opposite parameter as below:

$$\Delta x = -46.012 \text{ m}$$

$$\Delta y = +127.108 \text{ m}$$

$$\Delta z = +38.131 \text{ m}$$

Nongteng station (No.0001) and GPS K5 were base point transferring to new GPS amount 04 Pair (GPS 001, GPS002, GPS003, GPS004, GPS005, GPS006, GPS007, GPS008).

5.2.2 Survey Result

- Calculation and evaluation according to Lao National Geodetic Datum 1997.
- Coordinates value was calculation with Geodetic & Grid coordinates and WGS84 (DATUM: WGS 84).
- Coordinates calculation are as following:

Grid Coordinates

Point ID	Northing (Meter)	Easting (Meter)	Elevation (Meter)	Projection Scale Factor
NGD 0001	1994773.791	236964.123	223.583	1.0004556024
<u>GPS K5</u>	1989480.272	238316.702	173.125	1.0004468280
<u>GPS 001</u>	1994846.033	240356.107	171.710	1.0004336715
<u>GPS 002</u>	1995078.178	240350.044	171.845	1.0004339102
<u>GPS 003</u>	2008483.165	235717.978	180.473	1.0004637179
<u>GPS 004</u>	2008603.812	235726.291	179.282	1.0004636634
<u>GPS 005</u>	2023302.362	233111.994	169.989	1.0004808262
<u>GPS 006</u>	2023424.571	233017.973	169.832	1.0004814470
<u>GPS 007</u>	2037688.302	228122.371	182.936	1.0005140662
<u>GPS 008</u>	2037798.077	228144.792	182.104	1.0005139143

Adjusted Geodetic Coordinates

Point ID	Latitude	Longitude	Height (Meter)
<u>0001</u>	N18°01'31.85097"	E102°30'56.10786"	191.593
<u>GPS- K5</u>	N17°58'40.35455"	E102°31'44.46638"	141.138
<u>GPS - 001</u>	N18°01'35.67046"	E102°32'51.33337"	139.709
<u>GPS - 002</u>	N18°01'43.21465"	E102°32'51.02278"	139.843
<u>GPS - 003</u>	N18°08'56.96658"	E102°30'07.45600"	148.434
<u>GPS - 004</u>	N18°09'00.89221"	E102°30'07.68291"	147.242
<u>GPS - 005</u>	N18°16'57.53219"	E102°28'31.90226"	137.777
<u>GPS - 006</u>	N18°17'01.46248"	E102°28'28.64541"	137.618
<u>GPS - 007</u>	N18°24'42.88232"	E102°25'35.19435"	150.431
<u>GPS - 008</u>	N18°24'46.46086"	E102°25'35.90474"	149.597

5.3 Equipment

5.3.1 Survey Equipment

Survey equipment are as follows:

- Total stations (Leica TC 1100) 1 set
- Levels (Wild NA2) 1 set
- Levels (Wild NA28) 1 set
- Total stations (Leica TC 605) 1 set
- Total stations (Leica TS09) 1 set
- Total stations (Leica TS09 Plus) 1 set
- Total stations (Leica TS06 Plus) 1 set
- Measuring tape 50 m 1 No.
- Safety Shirt 30 No.
- Camera 1 No.

5.3.2 Computer Program

Computer program applications are as follows:

- Auto Desk Land desktop version 2004
- AutoCAD 2010
- Microsoft Word and Excel

5.4 Survey Work

Details site survey are:

(1) Topography Survey:

- Traversing
- Topographic
- Existing utility and obstructive data collection

5.4.1 Plan Survey

Carry out plan survey by using Total Station (Leica TS 06 Plus) for traverse, uses Levels (Leica) for level. Other that recorded obstructed and environment. The followings features may be shown in the plan drawings

- Existing Road centerline
- Structure (Culvert, Bridge and Other Structures)
- Trees
- All existing utilities
- Others (House, Temple, Road sign, etc.)

5.5 Accuracy of Survey

The followings accuracy has been applied for topographical survey

Descriptions		Tolerance	Remarks
Leveling Route	Elevation	$6\text{mm} \times \sqrt{D}$	D = Surveyed distance of one-way (km)
Traverse	Distance	$(1/20,000)$ or $0.2 \times \sqrt{D}$	D = Sum of all distance in Traverse (km)
	Angle	$10' \times \sqrt{N}$	N = Number of Instrument Station

5.6 Staff

- ◆ LTEC's Advisor: Mr. Vandy VORASACK

5.6.1 Field Survey Team

The field survey team crew for this project:

- ◆ Project Team Leader / Coordinator Engineer

1. Mr. Khamphone SORPHABMIXAY
2. Mr. Phoutsavanh PHIMMAVONG
3. Mr. Chittakone MANIPHONH
4. Mr. Southchay KEOMAHAVONG

- ◆ Survey Team

Topo Survey Team1

- | | |
|-----------------------|----------------------|
| 1. Mr. Serm | Surveyor Team Leader |
| 2. Mr. Viengkhone | Vice Surveyor |
| 3. Mr. Lamngern | Data processing |
| 4. Mr. Mathaly | Data processing |
| 5. Mr. Anphenghiamhuk | Assistant |
| 6. Mr. Xaysettha | Assistant |
| 7. Mr. Daovone | Driver |

Topo Survey Team 2

- | | |
|------------------|---------------|
| 1. Mr. Khampheuy | Surveyor Team |
| 2. Mr. Sommany | Vice Surveyor |
| 3. Mr. Nor | Assistant |
| 4. Mr. Thongkham | Assistant |
| 5. Mr. Thonkham | Driver |

Topo Survey Team 3

- | | |
|-----------------|---------------|
| 1. Mr. Vonechai | Surveyor Team |
|-----------------|---------------|

2. Mr. Sanxay	Vice Surveyor
3. Mr. Phovern	Assistant
4. Mr. Phonmany	Assistant
5. Mr. Paliya	Driver
Topo Survey Team 4	
1. Mr. Phonethip	Surveyor Team
2. Mr. Pouchai	Assistant
3. Mr. Phovorn	Assistant
4. Mr. Sounthone	Assistant
5. Mr. Vanhueng	Driver
Topo Survey Team 5	
1. Mr. Silivanh	Surveyor Team
2. Mr. Fuexong	Assistant
3. Mr. Sone	Assistant
4. Mr. Vanphoula	Assistant
5. Mr. Phovong	Driver
Drainage Survey Team	
1. Mr. Khampasong	Engineer
2. Mr. Tingkham	Engineer
3. Mr. Patiya	Assistant
4. Mr. Leokam	Assistant

5.6.2 Office Team

1. Data Processing: Mr. Lamngern .
2. Create Drawings: Mr. Phouthone OUTHAY.
3. Survey Report Prepare: Mr. Phoutsavanh PHIMMAVONG.
Ms. Manyda PHOTHIRATH.

5.7 List of Bench Marks

List of coordinates and level of BM 001 up to BM 055

Point No.	Code	Coordinates		Level	Remark
		X / E	Y / N	Z	
001	BM	240161.754	1997142.477	170.986	
002	BM	240172.402	1997246.943	172.724	
003	BM	239387.567	1999060.055	174.954	
004	BM	239248.855	1999219.247	175.858	
005	BM	238193.532	2001095.944	172.331	
006	BM	238057.142	2001187.047	172.497	
007	BM	237909.720	2001371.965	172.909	
008	BM	236517.829	2002399.757	172.217	
009	BM	236480.487	2002461.687	172.118	
010	BM	236503.794	2003695.374	174.318	
011	BM	236491.809	2003755.503	173.416	
012	BM	236330.569	2004287.095	173.354	
013	BM	236339.063	2004443.656	172.925	
014	BM	235902.921	2006455.078	175.187	
015	BM	235896.925	2006596.519	176.922	

016	BM	235614.408	2010277.864	179.582	
017	BM	235648.655	2010420.049	178.287	
018	BM	235667.868	2012519.066	173.056	
019	BM	235515.624	2012688.233	172.891	
020	BM	235390.031	2014472.530	171.495	
021	BM	235395.365	2014567.024	171.513	
022	BM	235323.025	2016446.876	171.969	
023	BM	235206.737	2016570.730	173.040	
024	BM	234444.545	2018015.941	171.992	
025	BM	234307.282	2018290.279	170.641	
026	BM	234130.688	2019482.089	172.640	
027	BM	234214.378	2019625.682	174.958	
028	BM	233903.285	2021466.986	176.243	
029	BM	233892.886	2021551.217	174.392	
030	BM	232198.172	2025227.994	171.216	
031	BM	232085.700	2025405.664	172.894	
032	BM	231266.999	2026973.191	172.464	

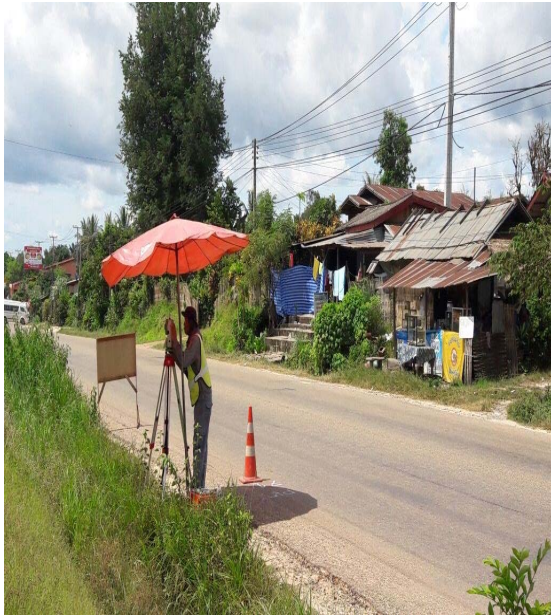
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034	BM	229860.003	2028511.256	178.808	
035	BM	229793.981	2028546.115	176.798	
036	BM	228510.940	2029969.775	179.370	
037	BM	228464.412	2030008.948	179.790	
038	BM	227853.711	2031750.552	187.845	
039	BM	227878.228	2031926.437	191.534	
040	BM	227942.221	2034382.435	179.213	
041	BM	227944.702	2034423.865	178.783	
042	BM	228009.474	2036157.989	181.557	
043	BM	228043.086	2036242.247	179.317	
044	BM	227989.659	2039714.534	191.272	
045	BM	227956.240	2039815.146	186.773	
046	BM	226490.503	2041061.664	181.925	
047	BM	226466.981	2041175.572	179.098	
048	BM	226481.202	2042779.483	184.923	
049	BM	226441.387	2042869.926	188.058	

050	BM	226517.802	2043894.044	180.107	
051	BM	226545.826	2043956.438	180.766	
052	BM	226803.840	2045900.735	177.683	
053	BM	226800.531	2046006.210	178.738	
054	BM	227175.755	2047098.912	177.368	
055	BM	227177.790	2047166.505	178.110	

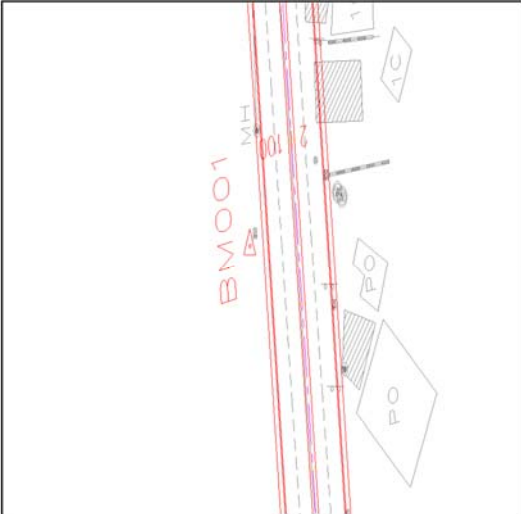
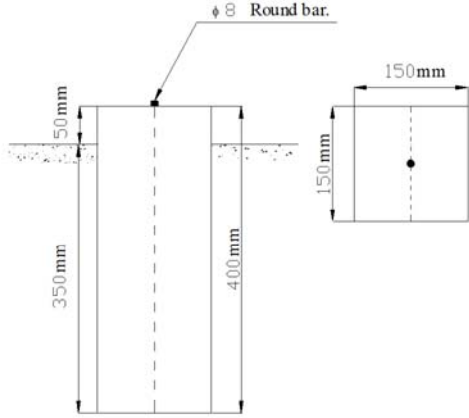

Appendices

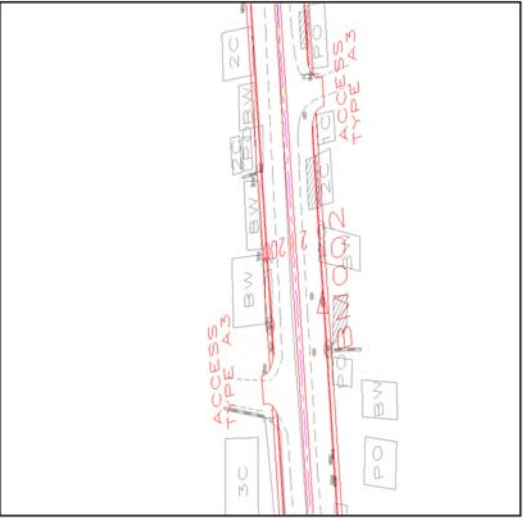
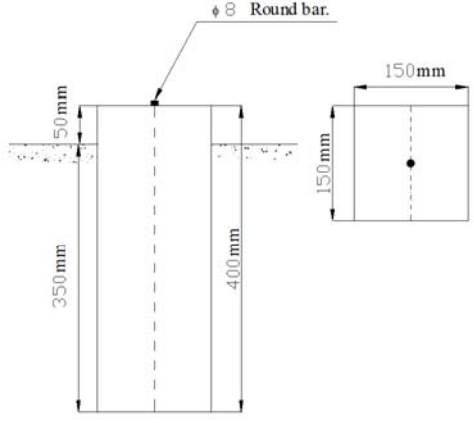

Appendix 1: Photographs of activity for Topographical Survey Works

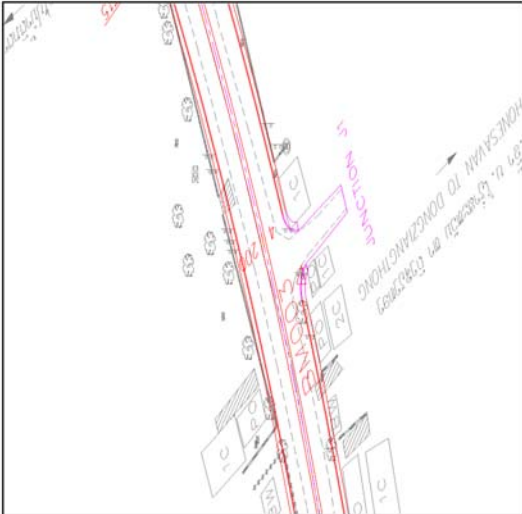
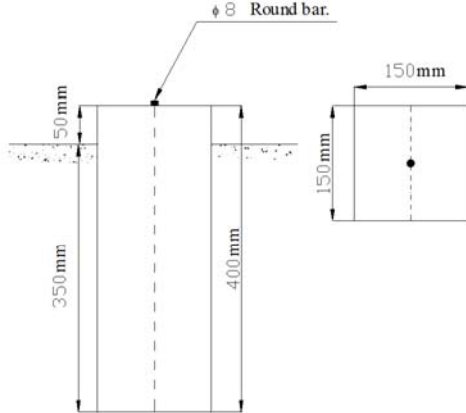



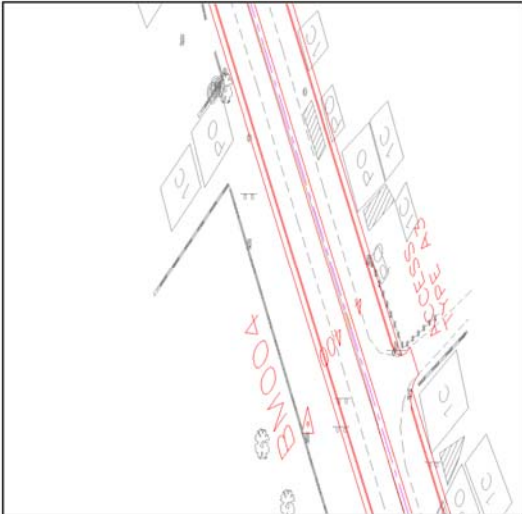
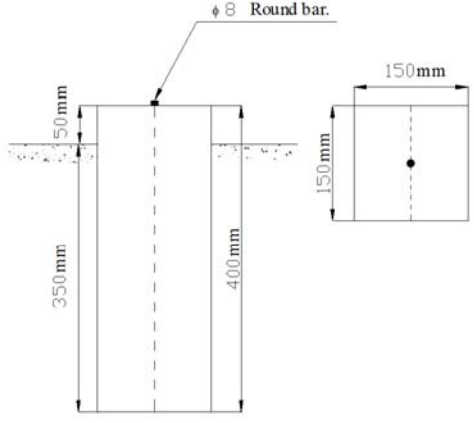



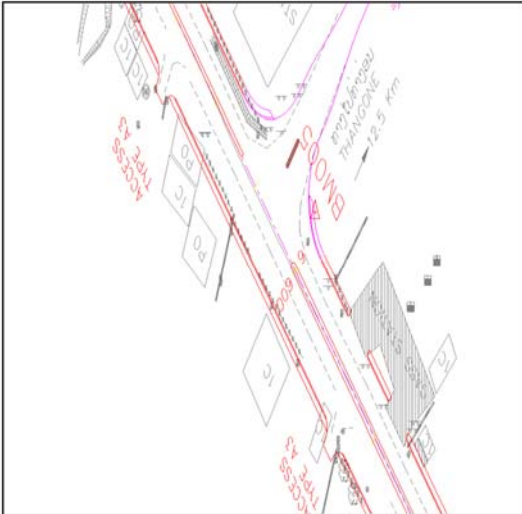
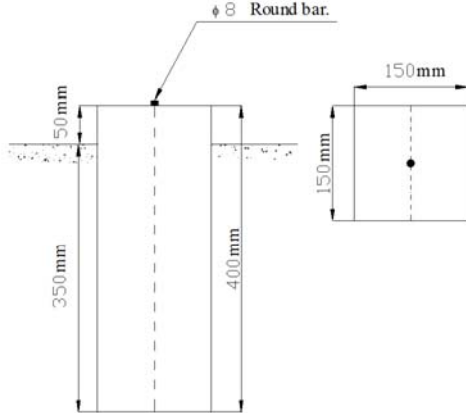

Appendix 2: Plan and Photograph of BM

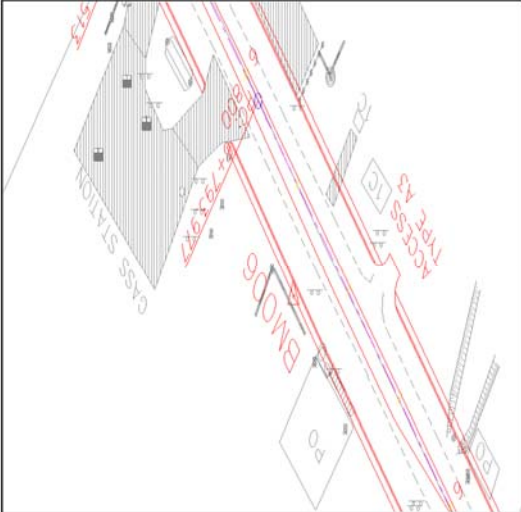
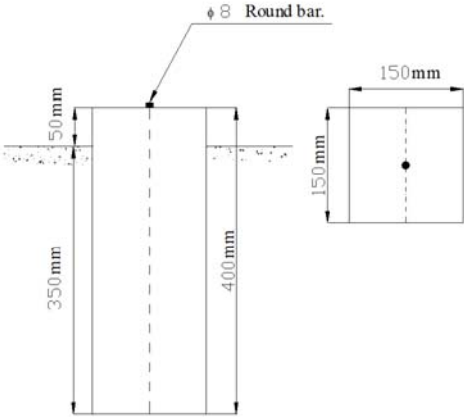

Point BM 001	
Elevation = 170.986	
Alignment: NR13 N	Zone
Coordinate of station	N = 1997142.477
	E = 240161.754
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

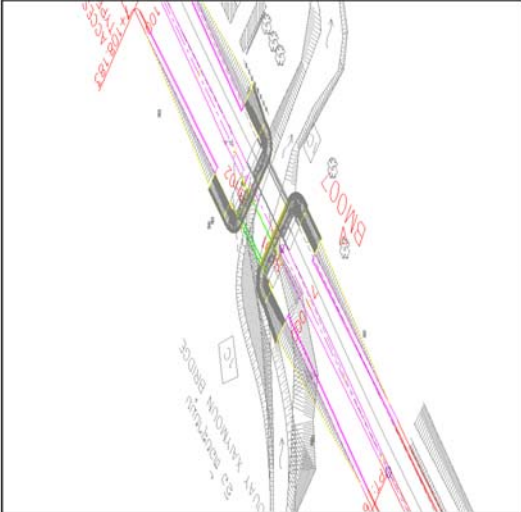
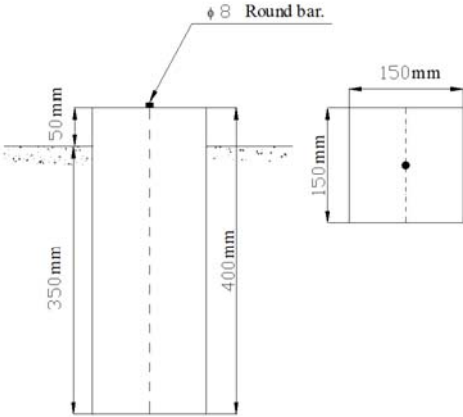

Point BM 002	
Elevation =	172.724
Alignment: NR13 N	Zone
Coordinate of station	N = 1997246.943
	E = 240172.402
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	


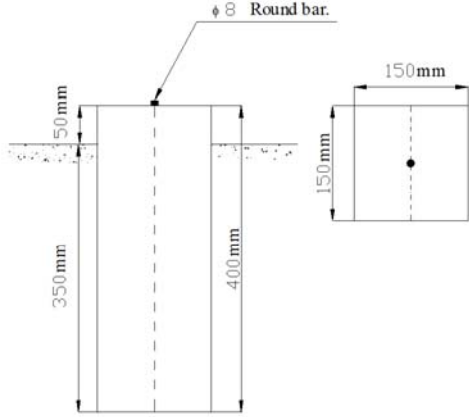

Point BM 003	
Elevation =	174.954
Alignment: NR13 N	Zone
Coordinate of station	N = 1999060.055
	E = 239387.567
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

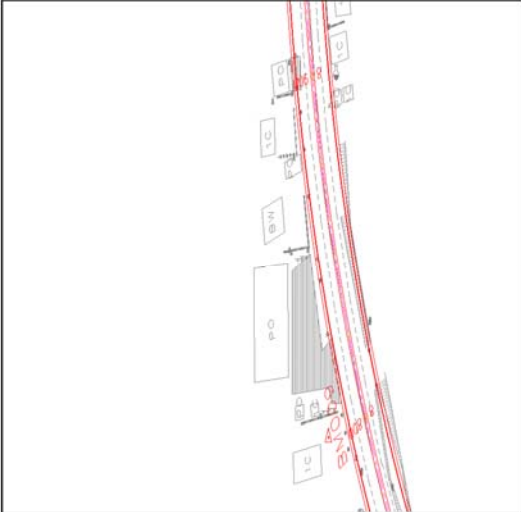
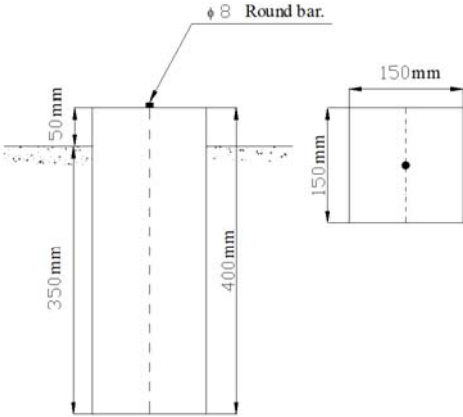

Point BM 004	
Elevation =	175.858
Alignment: NR13 N	Zone
Coordinate of station	N = 1999219.247
	E = 239248.855
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

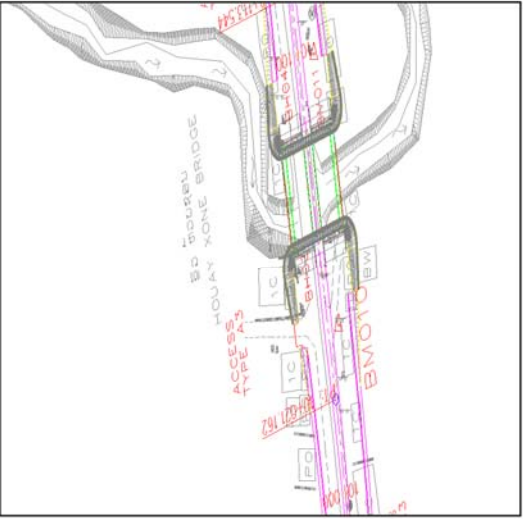
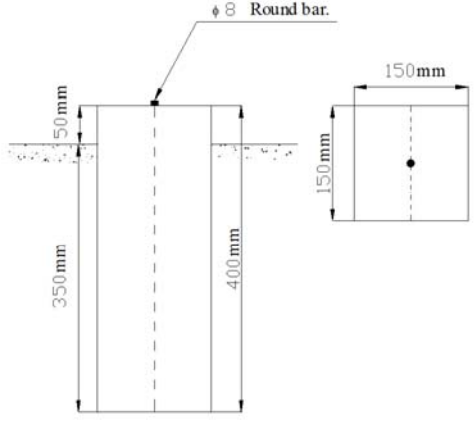

Point BM 005	
Elevation =	172.331
Alignment: NR13 N	Zone
Coordinate of station	N = 2001095.944
	E = 238193.532
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

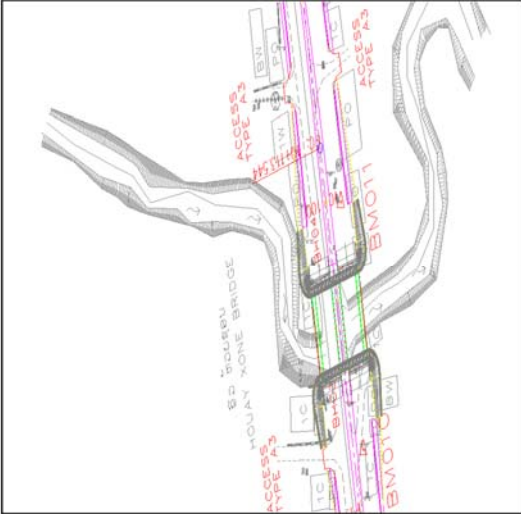
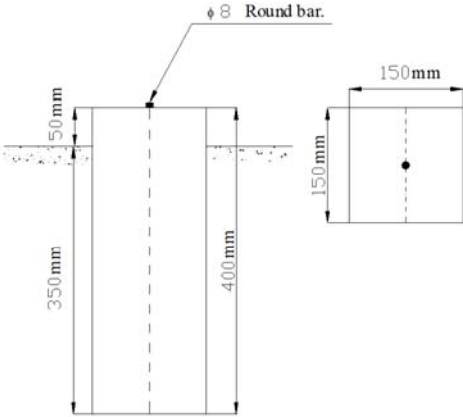

Point BM 006	
Elevation =	172.497
Alignment: NR13 N	Zone
Coordinate of station	N = 2001187.047
	E = 238057.142
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

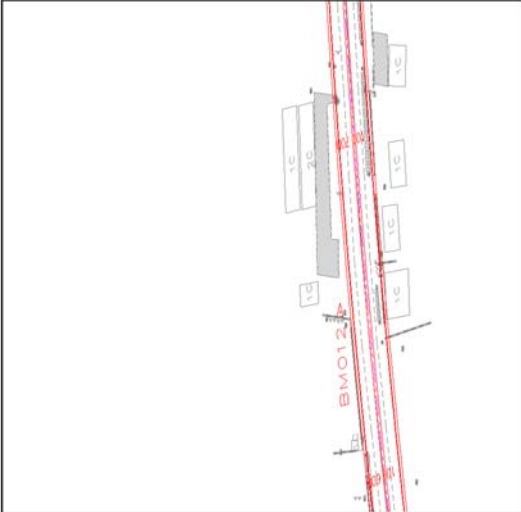
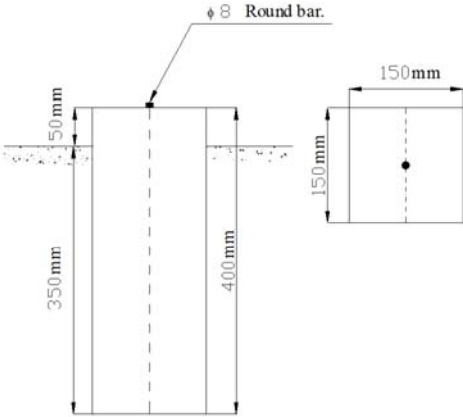

Point BM 007	
Elevation = 172.909	
Alignment: NR13 N	Zone
Coordinate of station	N = 2001371.965
	E = 237909.720
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	


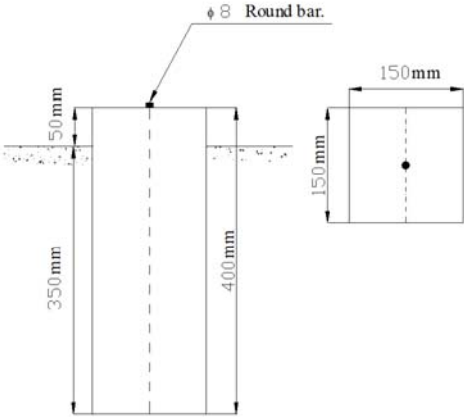

Point BM 008	
Elevation =	172.217
Alignment: NR13 N	Zone
Coordinate of station	N = 2002399.757
	E = 236517.829
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

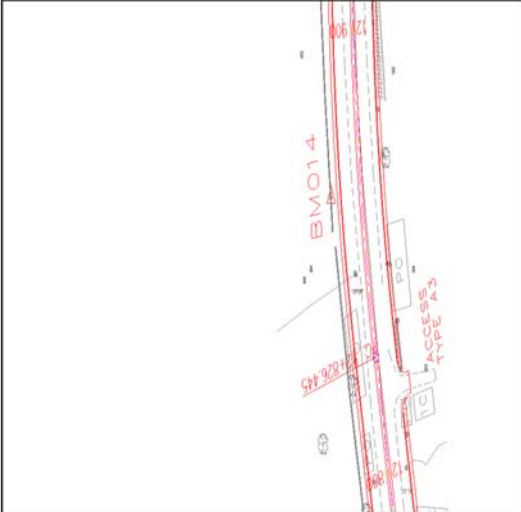
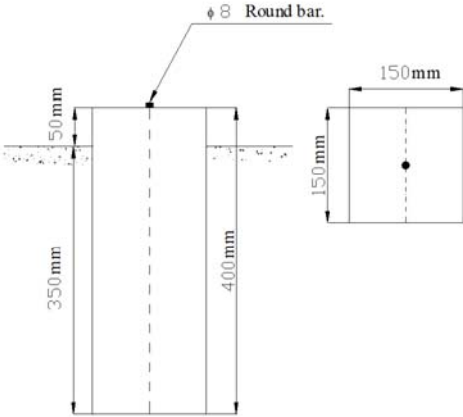

Point BM 009	
Elevation = 172.118	
Alignment: NR13 N	Zone
Coordinate of station	N = 2002461.687
	E = 236480.487
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

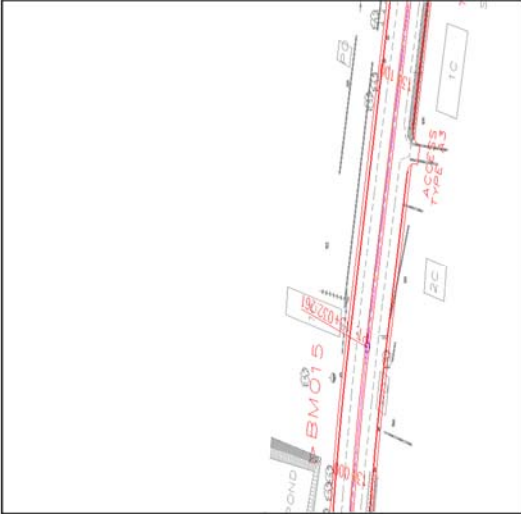
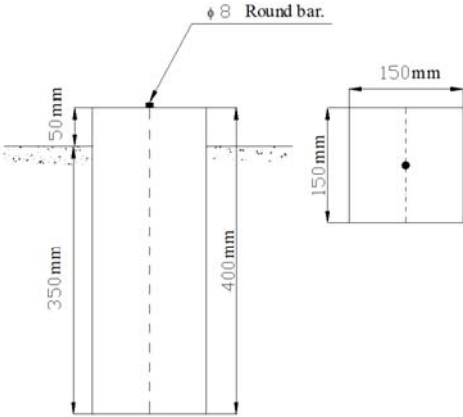

Point BM 010	
Elevation =	174.318
Alignment: NR13 N	Zone
Coordinate of station	N = 2003695.374
	E = 236503.794
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

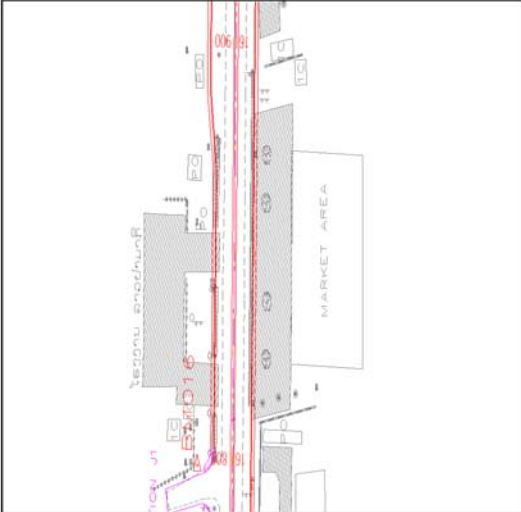
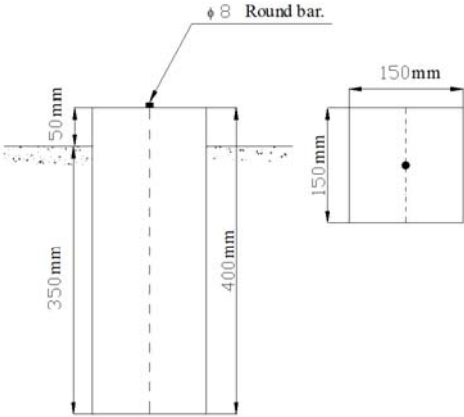

Point BM 011	
Elevation =	173.416
Alignment: NR13 N	Zone
Coordinate of station	N = 2003755.503
	E = 236491.809
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

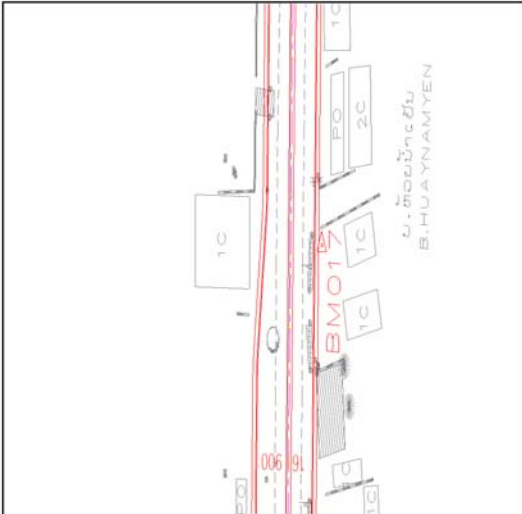
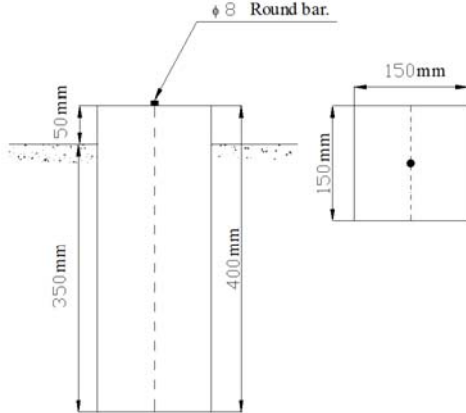

Point BM 012	
Elevation =	173.354
Alignment: NR13 N	Zone
Coordinate of station	N = 2004287.095
	E = 236330.569
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

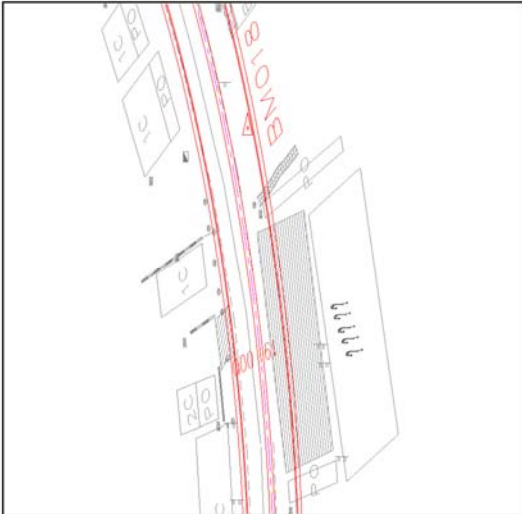
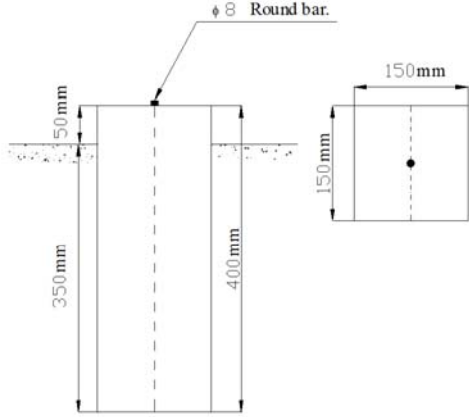

Point BM 013	
Elevation = 172.925	
Alignment: NR13 N	Zone
Coordinate of station	N = 2004443.656
	E = 236339.063
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

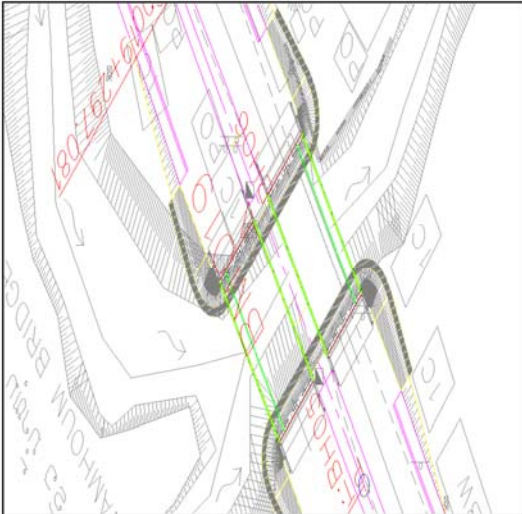
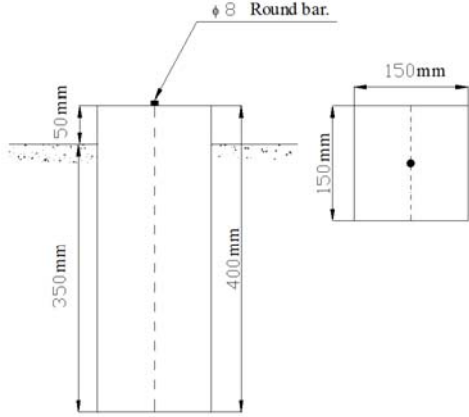

Point BM 014	
Elevation =	175.187
Alignment: NR13 N	Zone
Coordinate of station	N = 2006455.078
	E = 235902.921
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

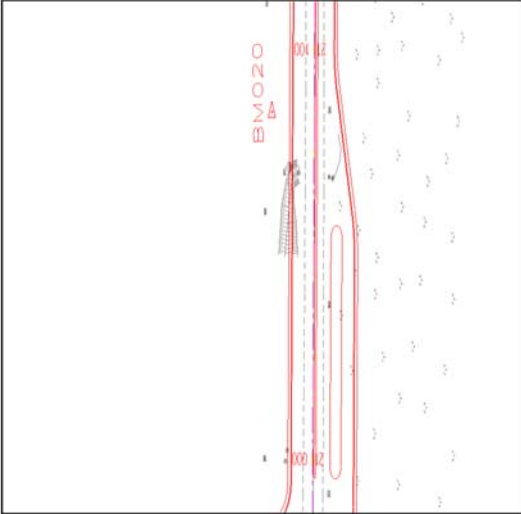
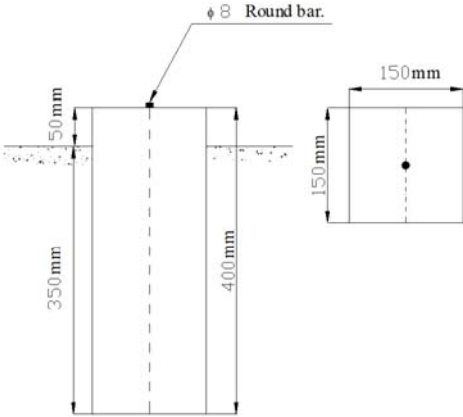

Point BM 015	
Elevation =	176.922
Alignment: NR13 N	Zone
Coordinate of station	N = 2006596.519
	E = 235896.925
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

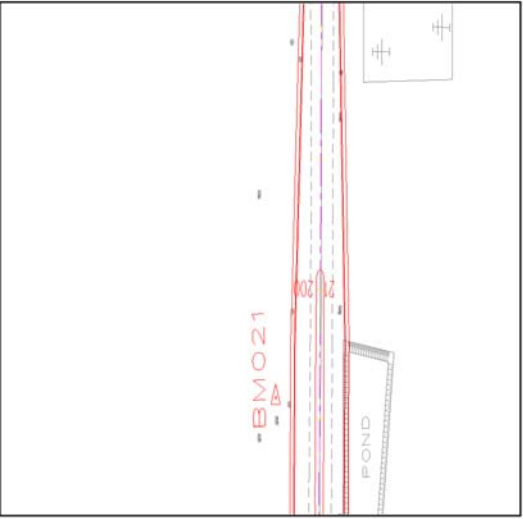
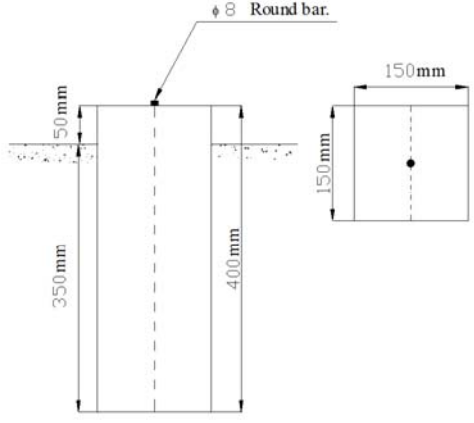

Point BM 016	
Elevation = 179.582	
Alignment: NR13 N	Zone
Coordinate of station	N = 2010277.864
	E = 235614.408
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

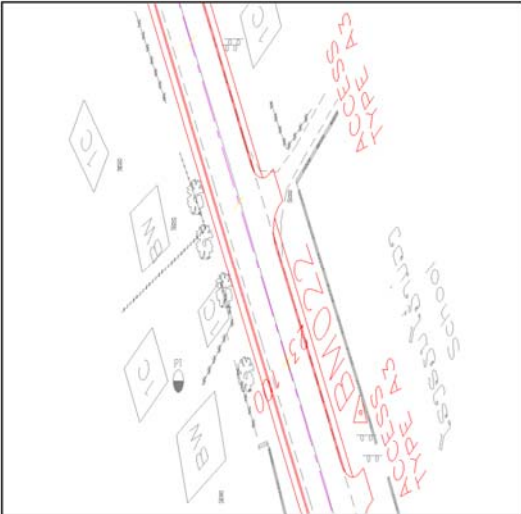
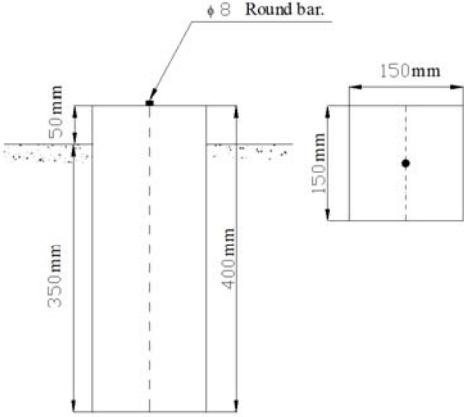

Point BM 017	
Elevation =	178.287
Alignment: NR13 N	Zone
Coordinate of station	N = 2010420.049
	E = 235648.655
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

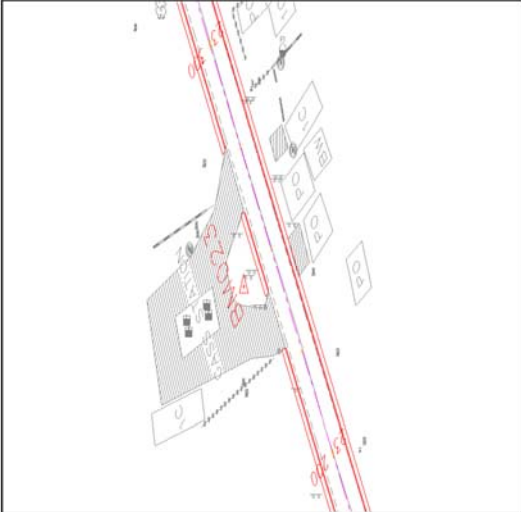
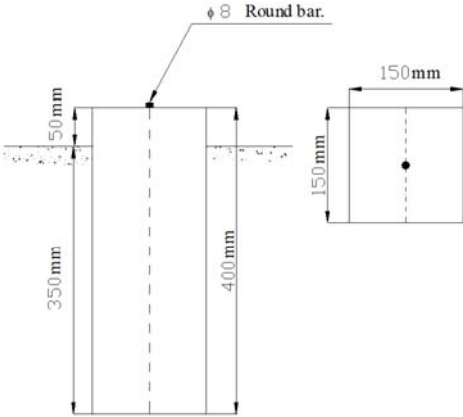

Point BM 018	
Elevation =	173.056
Alignment: NR13 N	Zone
Coordinate of station	N = 2012519.066
	E = 235667.868
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

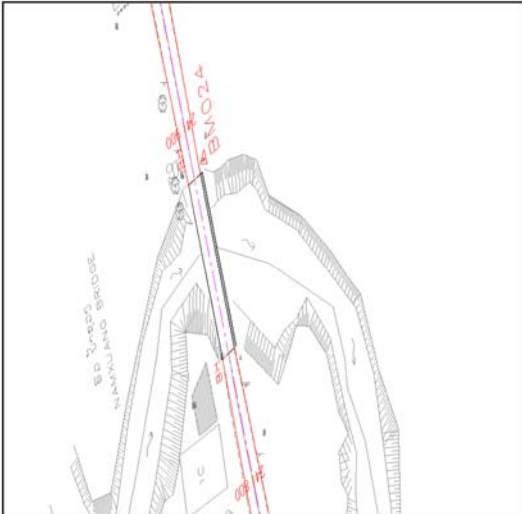
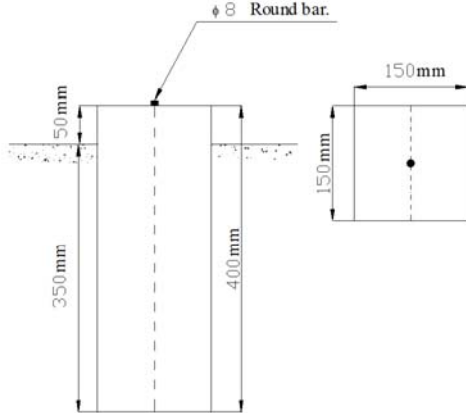

Point BM 019	
Elevation = 172.891	
Alignment: NR13 N	Zone
Coordinate of station	N = 2012688.233
	E = 235515.624
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

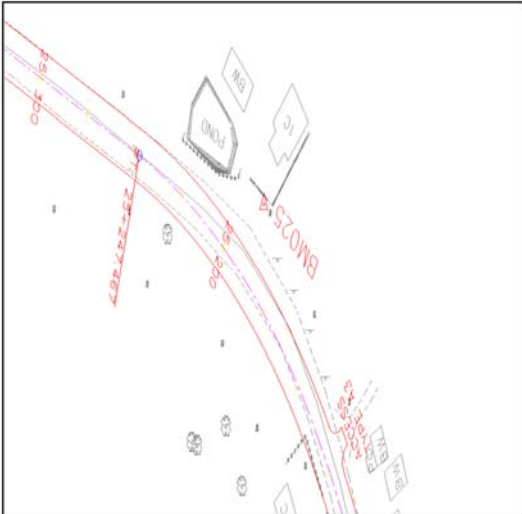
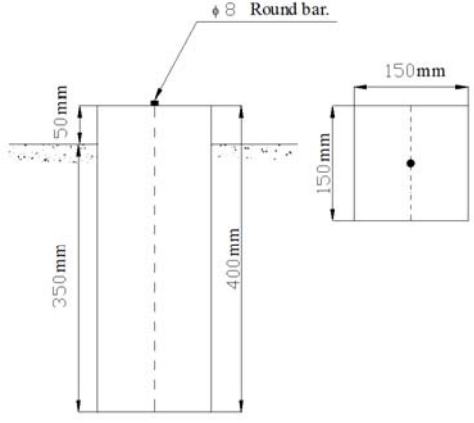

Point BM 020	
Elevation =	171.495
Alignment: NR13 N	Zone
Coordinate of station	N = 2014472.530
	E = 235390.031
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

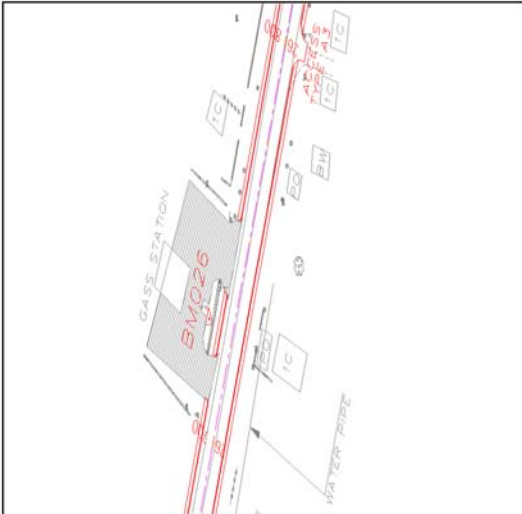
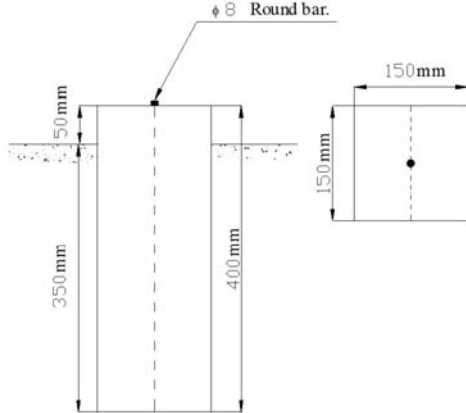

Point BM 021	
Elevation = 171.513	
Alignment: NR13 N	Zone
Coordinate of station	N = 2014567.024
	E = 235395.365
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

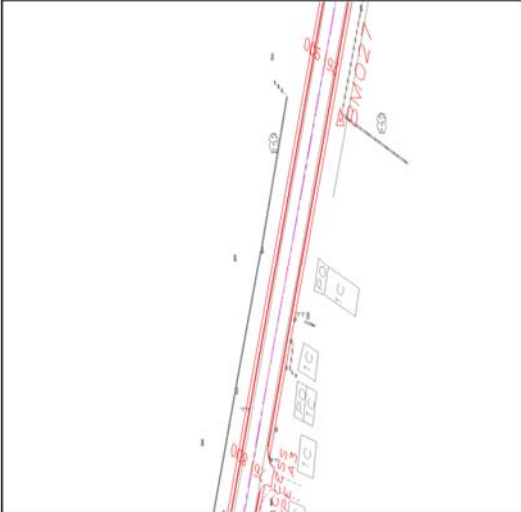
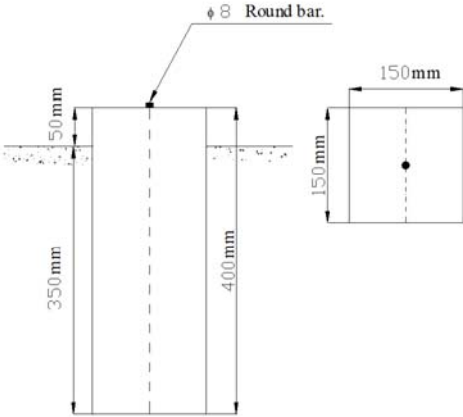

Point BM 022	
Elevation = 171.969	
Alignment: NR13 N	Zone
Coordinate of station	N = 2016446.876
	E = 235323.025
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

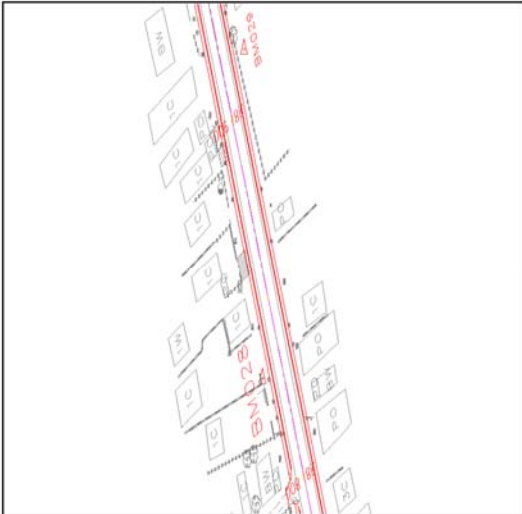
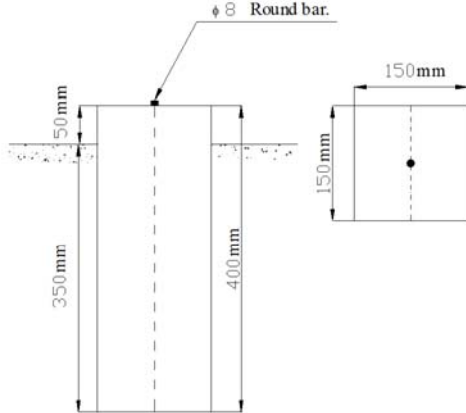

Point BM 023	
Elevation = 173.040	
Alignment: NR13 N	Zone
Coordinate of station	N = 2016570.730
	E = 235206.737
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

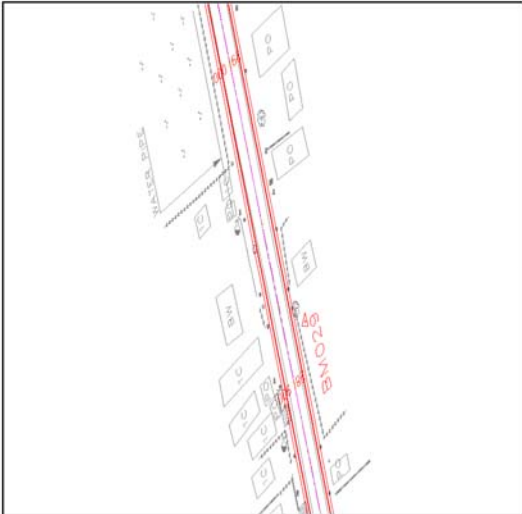
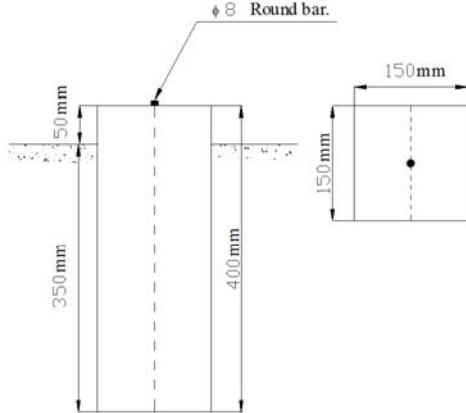

Point BM 024	
Elevation = 171.992	
Alignment: NR13 N	Zone
Coordinate of station	N = 2018015.941
	E = 234444.545
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
 <p>A topographic sketch map showing a road alignment with a bridge labeled '180 METERS NANANG BRIDGE'. A red line indicates the alignment, and a specific point is marked 'BM 024' with a red dot. The map shows terrain contours and some buildings.</p>	 <p>Diagram of the physical bench mark. It consists of a vertical rod of diameter $\phi 8$ Round bar. The main body is 350 mm high and 150 mm wide. The base is 400 mm deep and 150 mm wide. A 50 mm section is shown at the top of the rod.</p>
Photograph	
 <p>A photograph of the physical bench mark in the field. It is a red metal rod with a red sign that reads 'BM 024 L/TEC'. The rod is set in a concrete base. The background shows lush green vegetation.</p>	

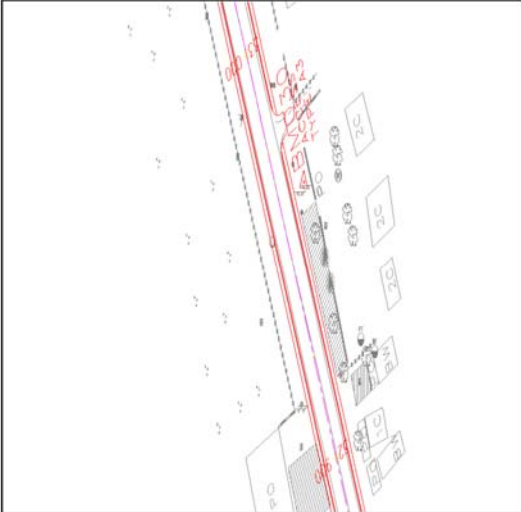
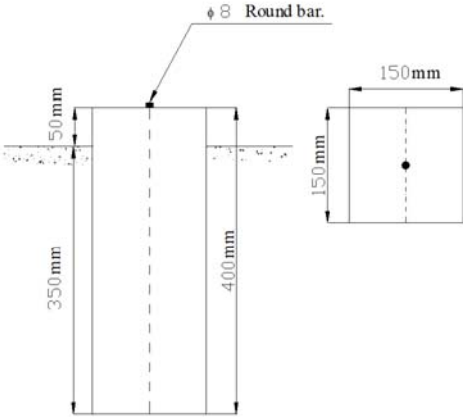

Point BM 025	
Elevation =	170.641
Alignment: NR13 N	Zone
Coordinate of station	N = 2018290.279
	E = 234307.282
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

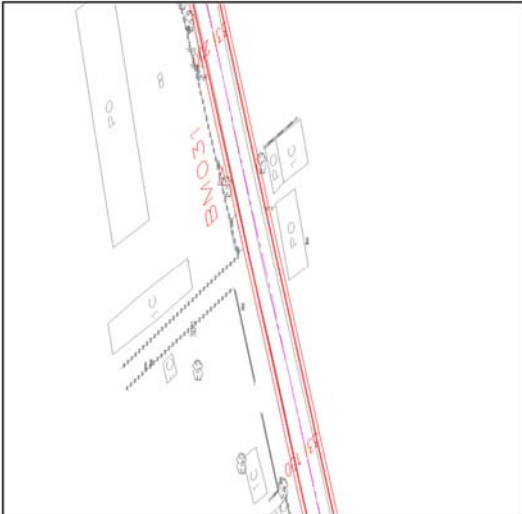
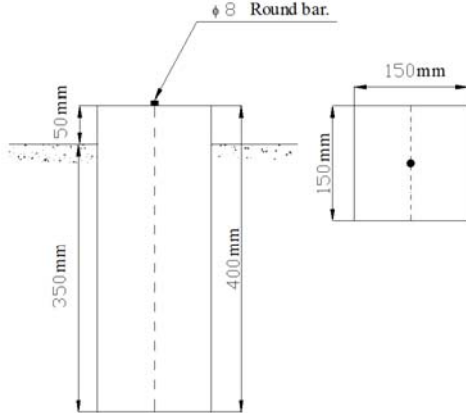

Point BM 026	
Elevation =	172.640
Alignment: NR13 N	Zone
Coordinate of station	N = 2019482.089
	E = 234130.688
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

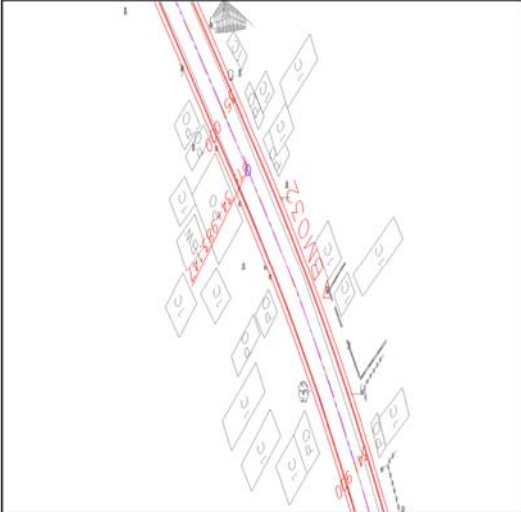
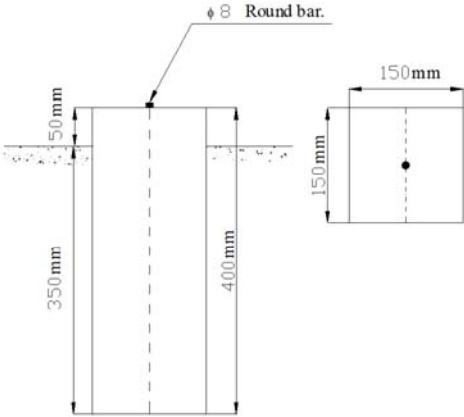

Point BM 027	
Elevation = 174.958	
Alignment: NR13 N	Zone
Coordinate of station	N = 2019625.682
	E = 234214.378
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

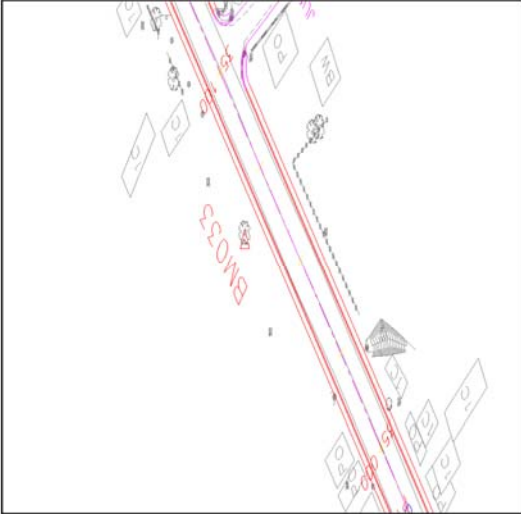
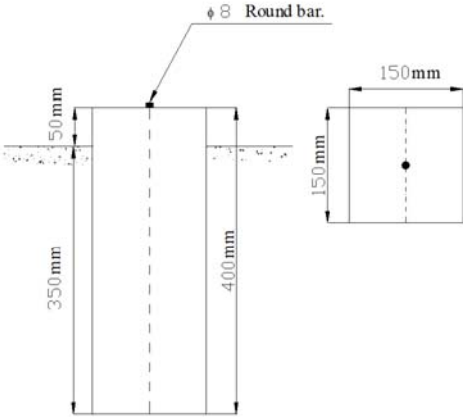

Point BM 028	
Elevation =	176.243
Alignment: NR13 N	Zone
Coordinate of station	N = 2021466.986
	E = 233903.285
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

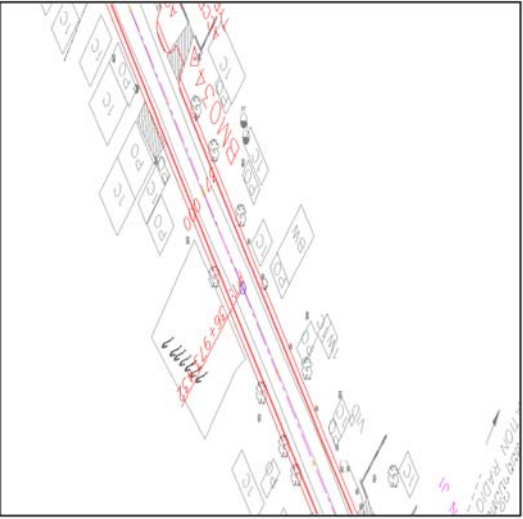
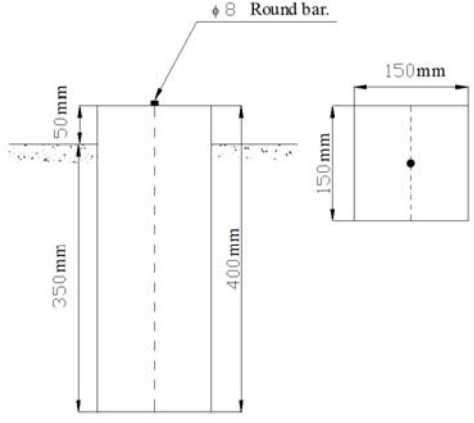

Point BM 029	
Elevation = 174.392	
Alignment: NR13 N	Zone
Coordinate of station	N = 2021551.217
	E = 233892.886
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

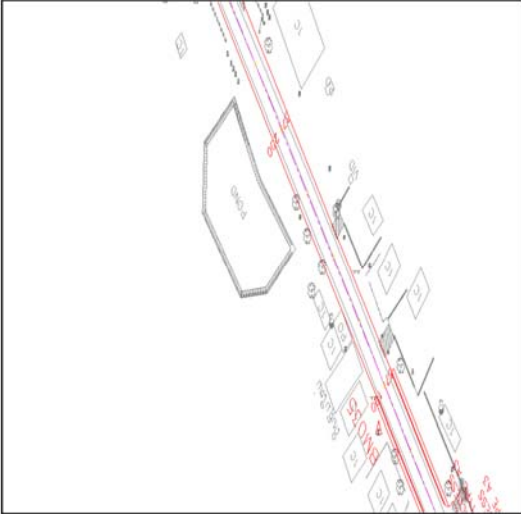
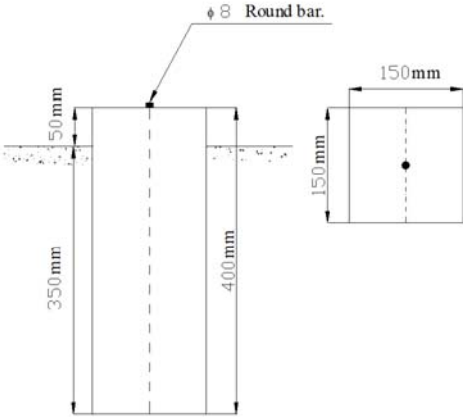

Point BM 030	
Elevation = 171.216	
Alignment: NR13 N	Zone
Coordinate of station	N = 2025227.994
	E = 232198.172
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

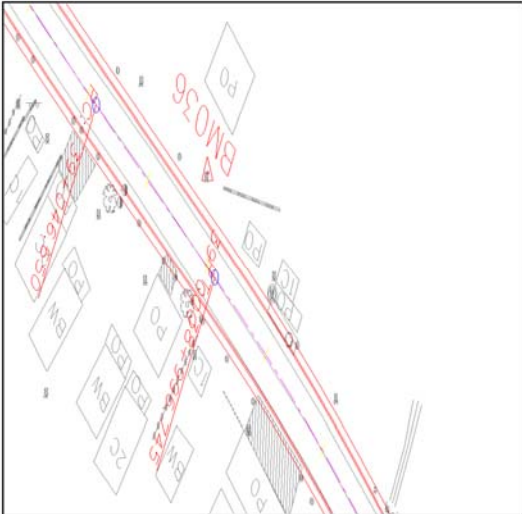
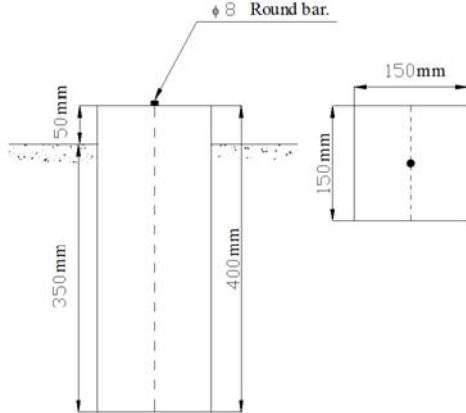

Point BM 031	
Elevation =	172.894
Alignment: NR13 N	Zone
Coordinate of station	N = 2025405.664
	E = 232085.700
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

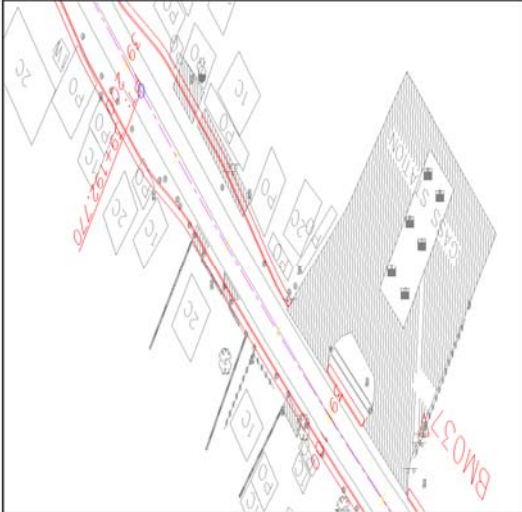
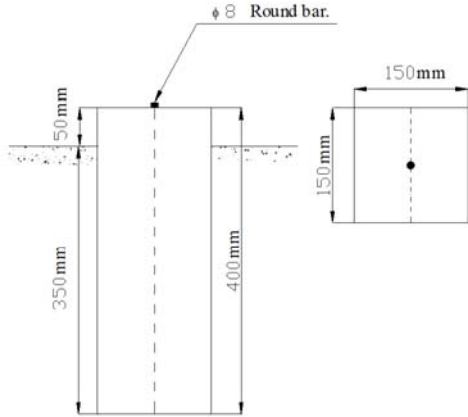

Point BM 032	
Elevation = 172.464	
Alignment: NR13 N	Zone
Coordinate of station	N = 2026973.191
	E = 231266.999
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

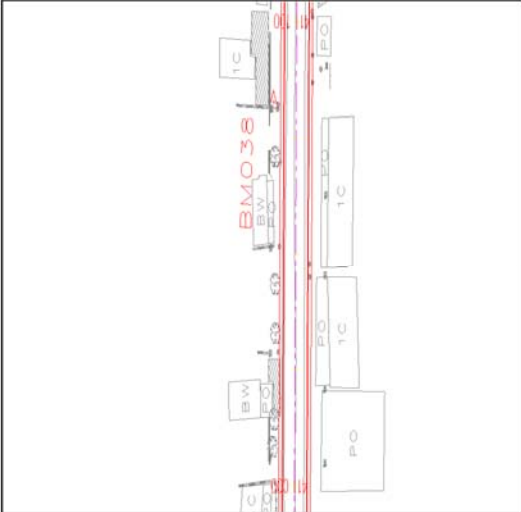
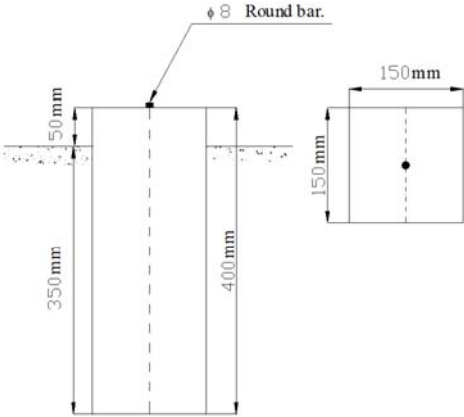

Point BM 033	
Elevation =	172.305
Alignment: NR13 N	Zone
Coordinate of station	N = 2027052.061
	E = 231159.153
Location Sikeuth Junction - Phonhong	
Sketch map	Physical size of bench mark
	
<p>Photograph</p> 	


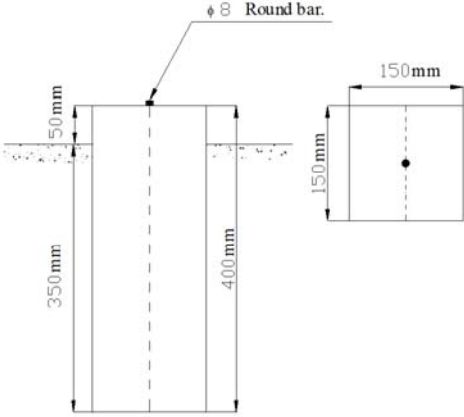

Point BM 034	
Elevation = 178.808	
Alignment: NR13 N	Zone
Coordinate of station	N = 2028511.256
	E = 229860.003
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

Point BM 035	
Elevation = 176.798	
Alignment: NR13 N	Zone
Coordinate of station	N = 2028546.115
	E = 229793.981
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

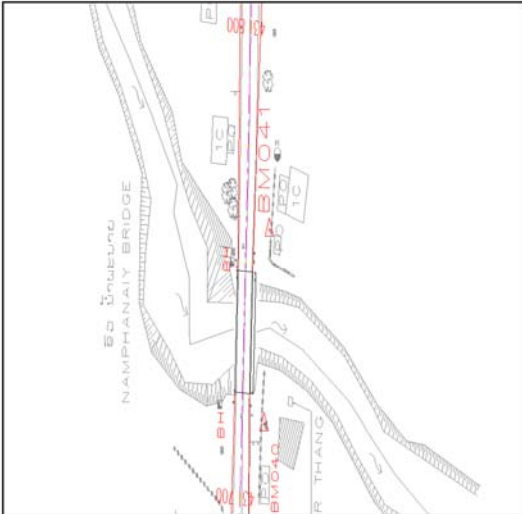
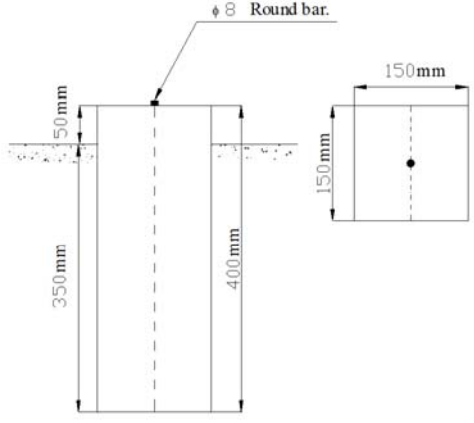

Point BM 036	
Elevation =	179.370
Alignment: NR13 N	Zone
Coordinate of station	N = 2029969.775
	E = 228510.940
Location	Sikeuth Junction - Phonhong
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

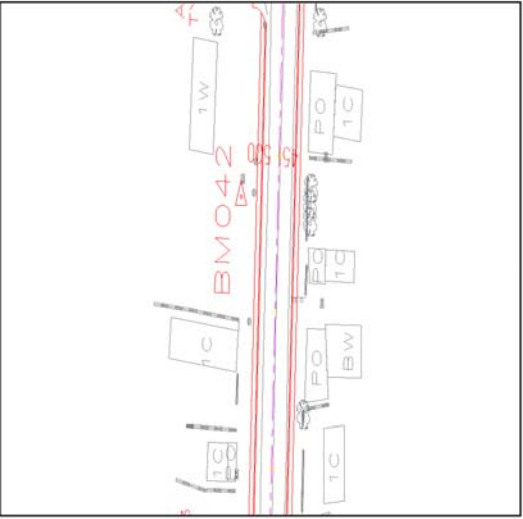
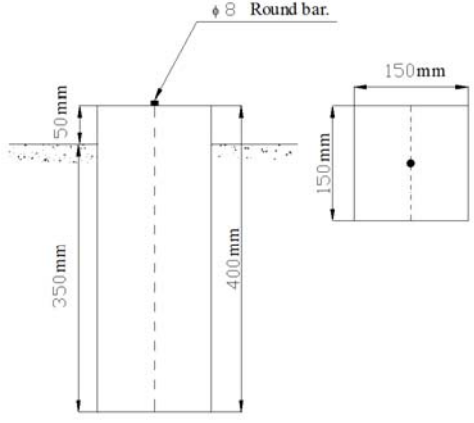

Point BM 037	
Elevation =	179.790
Alignment: NR13 N	Zone
Coordinate of station	N = 2030008.948
	E = 228464.412
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

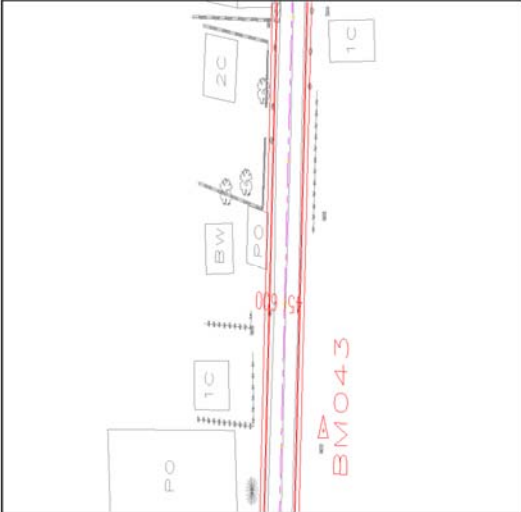
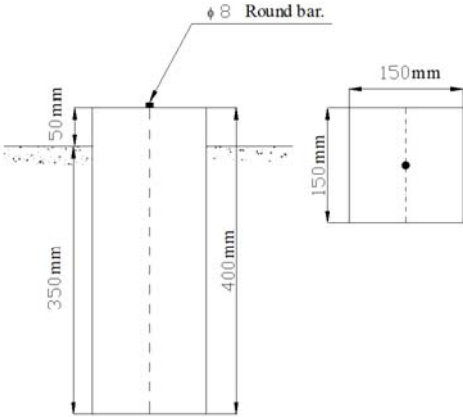

Point BM 038	
Elevation =	187.845
Alignment: NR13 N	Zone
Coordinate of station	N = 2031750.552
	E = 227853.711
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

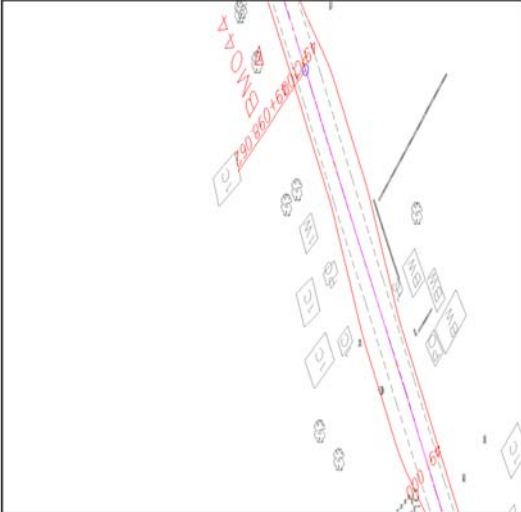
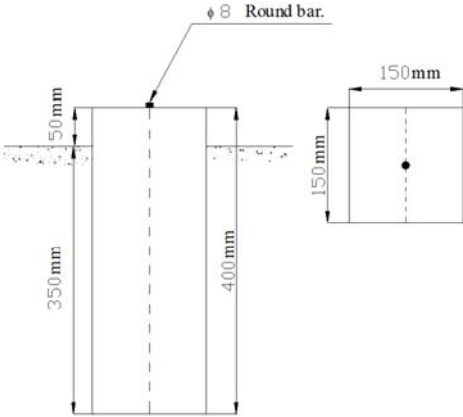

Point BM 039	
Elevation = 191.534	
Alignment: NR13 N	Zone
Coordinate of station	N = 2031926.437
	E = 227878.228
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

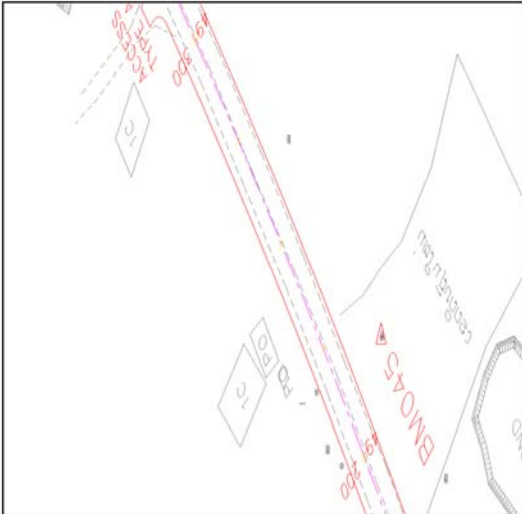
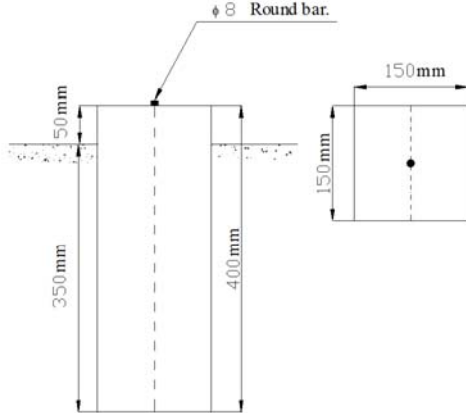

Point BM 040	
Elevation =	179.213
Alignment: NR13 N	Zone
Coordinate of station	N = 2034382.435
	E = 227942.221
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p>	<p><u>Physical size of bench mark</u></p>
<p>Photograph</p>	

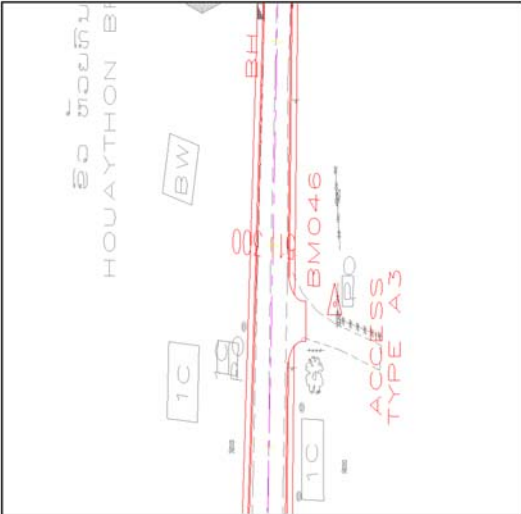
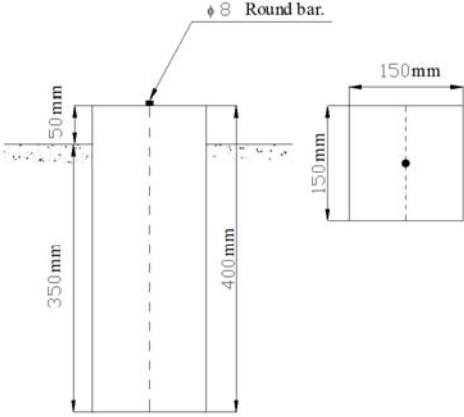

Point BM 041	
Elevation =	178.783
Alignment: NR13 N	Zone
Coordinate of station	N = 2034423.865
	E = 227944.702
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

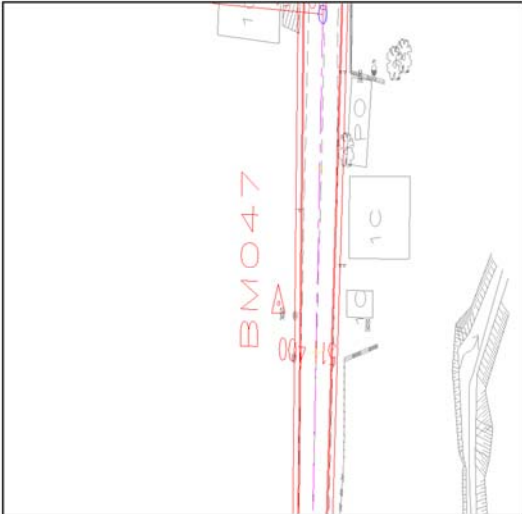
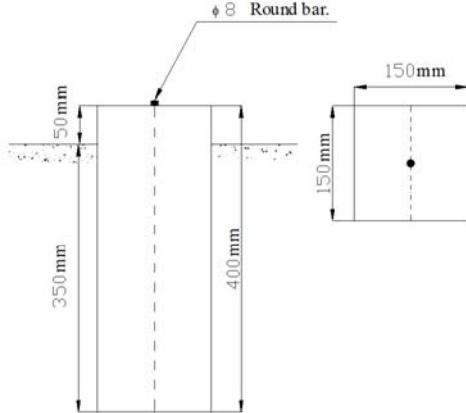

Point BM 042	
Elevation =	181.557
Alignment: NR13 N	Zone
Coordinate of station	N = 2036157.989
	E = 228009.474
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

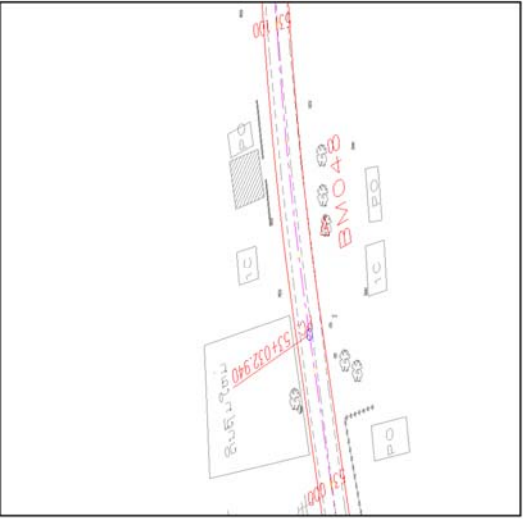
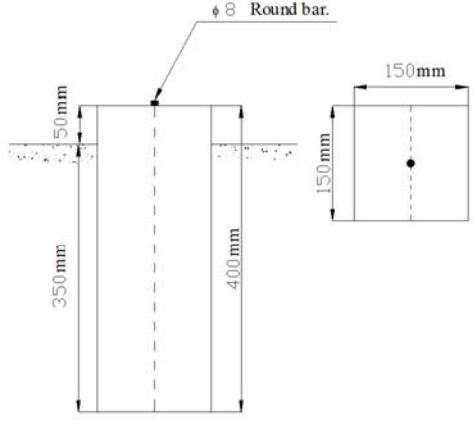

Point BM 043	
Elevation =	179.317
Alignment: NR13 N	Zone
Coordinate of station	N = 2036242.247
	E = 228043.086
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

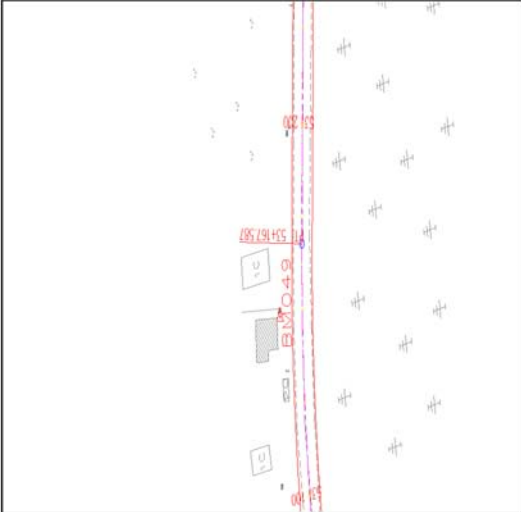
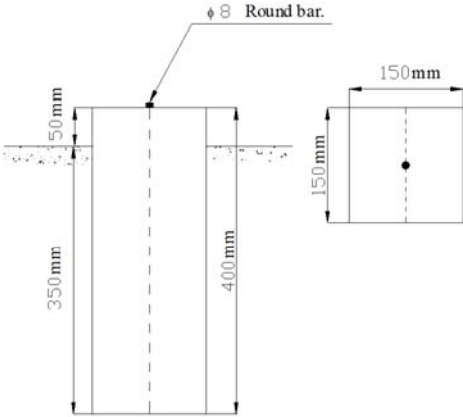

Point BM 044	
Elevation =	191.272
Alignment: NR13 N	Zone
Coordinate of station	N = 2039714.534
	E = 227989.659
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

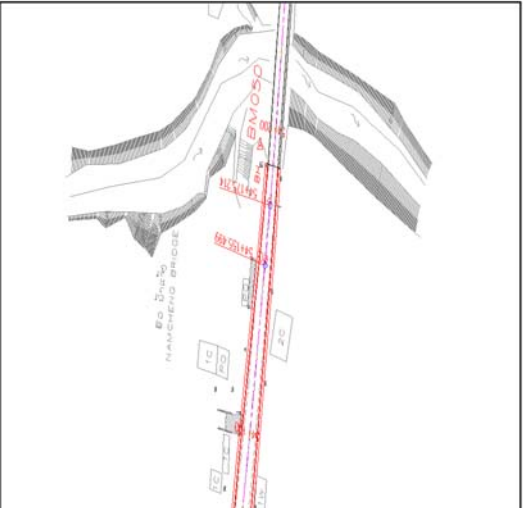
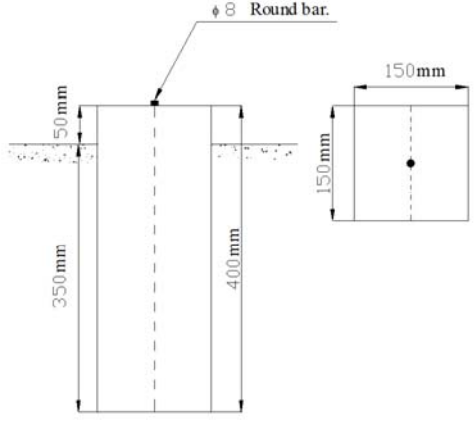

Point BM 045	
Elevation =	186.773
Alignment: NR13 N	Zone
Coordinate of station	N = 2039815.146
	E = 227956.240
Location Sikeuth Junction - Phonhong	
Sketch map	Physical size of bench mark
	
<p>Photograph</p> 	

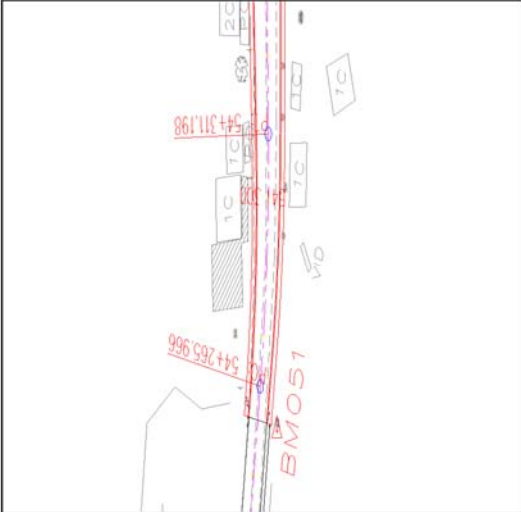
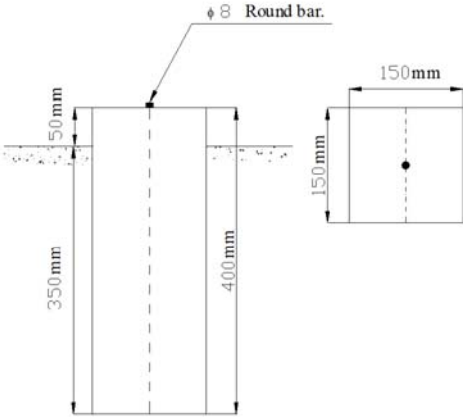

Point BM 046	
Elevation = 181.925	
Alignment: NR13 N	Zone
Coordinate of station	N = 2041061.664
	E = 226490.503
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

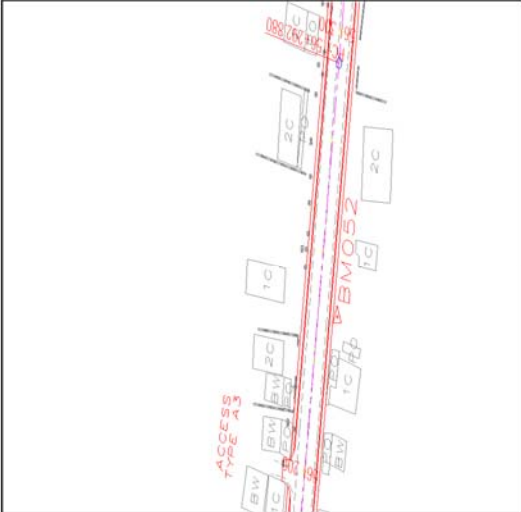
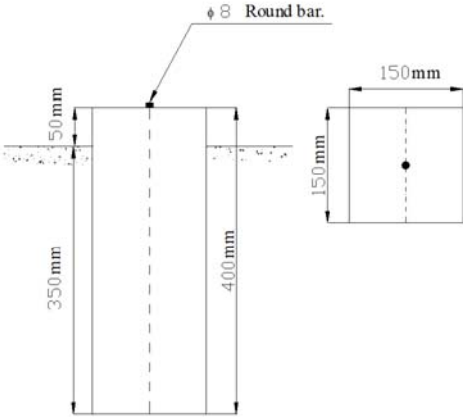

Point BM 047	
Elevation =	179.098
Alignment: NR13 N	Zone
Coordinate of station	N = 2041175.572
	E = 226466.981
Location Sikeuth Junction - Phonhong	
Sketch map	Physical size of bench mark
	
<p>Photograph</p> 	


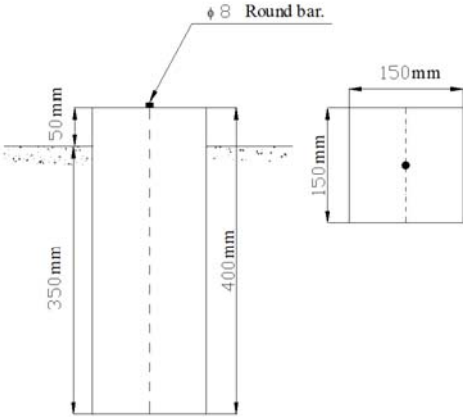

Point BM 048	
Elevation =	184.923
Alignment: NR13 N	Zone
Coordinate of station	N = 2042779.483
	E = 226481.202
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

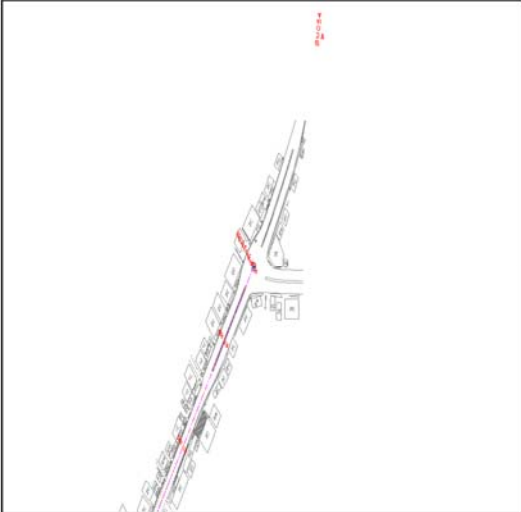
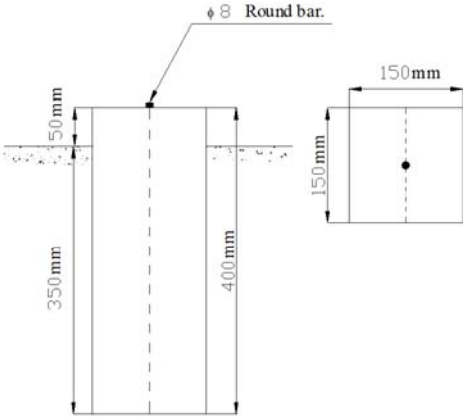

Point BM 049	
Elevation = 188.058	
Alignment: NR13 N	Zone
Coordinate of station	N = 2042869.926
	E = 226441.387
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	


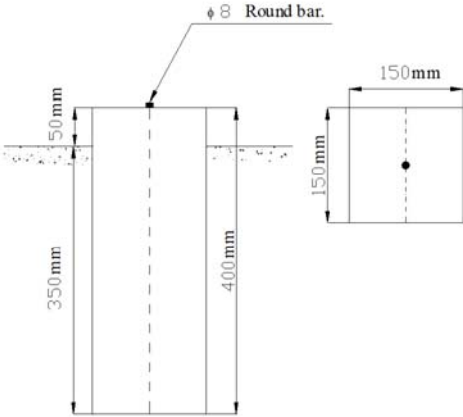

Point BM 050	
Elevation =	180.107
Alignment: NR13 N	Zone
Coordinate of station	N = 2043894.044
	E = 226517.802
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

Point BM 051	
Elevation =	180.766
Alignment: NR13 N	Zone
Coordinate of station	N = 2043956.438
	E = 226545.826
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

Point BM 052	
Elevation =	177.683
Alignment: NR13 N	Zone
Coordinate of station	N = 2045900.735
	E = 226803.840
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

Point BM 052	
Elevation =	178.738
Alignment: NR13 N	Zone
Coordinate of station	N = 2046006.210
	E = 226800.531
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

Point BM 054	
Elevation =	177.368
Alignment: NR13 N	Zone
Coordinate of station	N = 2047098.912
	E = 227175.755
Location Sikeuth Junction - Phonhong	
<u>Sketch map</u>	<u>Physical size of bench mark</u>
	
Photograph	
	

Point BM 055	
Elevation =	178.110
Alignment: NR13 N	Zone
Coordinate of station	N = 2047166.505
	E = 227177.790
Location Sikeuth Junction - Phonhong	
<p><u>Sketch map</u></p> 	<p><u>Physical size of bench mark</u></p> 
<p>Photograph</p> 	

Appendix 3: Traverse computing sheets

Project :
Date :
Checked :

Surveyor :
Instrument :
Approved :

OPEN TRAVERSE COMPUTING SHEET

Station	Observed Angle (A)			co-mp.	Forward Bearing (v)			H.Dist. (d)	Grid Dist. (D)	DY/DE d.sin(v)	comp.	DX/DN d.cos(v)	comp.	Co-ordinates		station No.	Elevation	
	o	'	"		o	'	"							Y/E	X/N			
	m	m	m		m	m	m							m	m			
GPS001															240356.107	-1994846.033	GPS001	171.710
GPS002															240350.044	-1995078.178	GPS002	171.863
PKT01	88	32	37	0.87	24	26	52	95.404	95.447	39.502	-0.007	86.889	-0.003	240389.539	1995165.064	PKT01	172.098	
PKT02	255	28	8	0.87	292	59	30	23.150	23.160	-21.321	-0.002	9.046	-0.001	240368.217	1995174.110	PKT02	171.983	
PKT03	164	20	39	0.87	8	27	39	313.572	313.713	46.157	-0.023	310.299	-0.008	240414.350	1995484.400	PKT03	172.005	
PKT04	176	40	21	0.87	352	48	19	262.904	263.022	-32.942	-0.020	260.951	-0.007	240381.389	1995745.344	PKT04	171.196	
PKT05	185	58	8	0.87	349	28	40	348.353	348.509	-63.643	-0.026	342.649	-0.009	240317.720	1996087.984	PKT05	171.651	
PKT06	176	38	45	0.87	355	26	49	305.850	305.987	-24.289	-0.023	305.022	-0.008	240293.408	1996392.998	PKT06	173.866	
PKT07	168	21	26	0.87	352	5	35	142.953	143.017	-19.674	-0.011	141.657	-0.004	240273.724	1996534.651	PKT07	174.815	
PKT08	194	36	55	0.87	340	27	2	87.928	87.967	-29.436	-0.007	82.896	-0.002	240244.281	1996617.545	PKT08	174.390	
PKT09	171	33	43	0.87	355	3	58	280.319	280.445	-24.120	-0.021	279.406	-0.007	240220.140	1996896.944	PKT09	171.888	
BM001	199	11	44	0.87	346	37	42	252.269	252.382	-58.368	-0.019	245.540	-0.007	240161.754	1997142.477	BM001	170.986	
BM002	161	04	46	0.87	5	49	27	104.964	105.011	10.656	-0.008	104.469	-0.003	240172.402	1997246.943	BM002	172.724	
PKT10	161	00	21	0.87	346	54	14	218.421	218.519	-49.514	-0.016	212.836	-0.006	240122.872	1997459.773	PKT10	171.592	
PKT11	179	49	49	0.87	327	54	35	235.553	235.659	-125.194	-0.018	199.653	-0.006	239997.660	1997659.420	PKT11	170.907	
PKT12	180	00	49	0.87	327	44	25	229.188	229.291	-122.386	-0.017	193.877	-0.006	239875.257	1997853.311	PKT12	170.751	
PKT13	179	33	41	0.87	327	45	15	215.457	215.554	-115.009	-0.016	182.308	-0.006	239760.232	1998035.614	PKT13	170.771	
PKT14	183	24	31	0.87	327	18	57	219.641	219.740	-118.661	-0.016	184.946	-0.006	239641.555	1998220.554	PKT14	171.547	
PKT15	195	52	48	0.87	330	43	29	200.548	200.638	-98.113	-0.015	175.013	-0.005	239543.427	1998395.561	PKT15	171.534	
PKT16	179	45	54	0.87	346	36	18	222.451	222.551	-61.577	-0.017	216.497	-0.006	239491.853	1998612.052	PKT16	171.246	
PKT17	181	20	21	0.87	346	22	13	277.716	277.841	-65.473	-0.021	270.016	-0.007	239426.360	1998882.060	PKT17	172.501	
BM003	151	13	37	0.87	347	42	35	182.093	182.175	-38.779	-0.014	178.000	-0.005	239387.567	1999060.055	BM003	174.954	
BM004	199	58	16	0.87	318	56	12	211.046	211.141	-138.697	-0.016	159.197	-0.006	239248.855	1999219.247	BM004	175.858	
PKT18	165	19	9	0.87	338	54	29	122.561	122.616	-44.125	-0.009	114.401	-0.003	239204.721	1999333.645	PKT18	174.135	
PKT19	207	56	22	0.87	324	11	39	236.750	236.843	-127.404	-0.019	167.750	-0.006	239083.694	1999501.303	PKT19	172.904	
PKT20	185	44	37	0.87	352	8	2	219.419	219.517	-30.043	-0.016	217.452	-0.006	239051.635	1999718.836	PKT20	173.895	
PKT21	168	30	0	0.87	357	52	40	220.665	220.764	-8.175	-0.016	220.613	-0.006	239045.443	1999939.442	PKT21	173.746	
PKT22	153	34	55	0.87	346	22	41	110.125	110.174	-25.948	-0.008	107.075	-0.003	239019.487	2000046.515	PKT22	173.518	
PKT23	184	34	32	0.87	319	57	37	150.154	150.221	-95.740	-0.011	115.009	-0.004	238922.835	2000161.520	PKT23	172.871	
PKT24	185	29	24	0.87	324	32	9	264.846	264.965	-153.630	-0.020	215.809	-0.007	238769.085	2000377.321	PKT24	172.546	
PKT25	174	53	35	0.87	330	1	34	148.060	148.126	-74.005	-0.011	128.315	-0.004	238695.070	2000505.633	PKT25	172.602	
PKT26	178	21	53	0.87	324	55	10	145.123	145.188	-83.444	-0.011	118.814	-0.004	238611.615	2000624.443	PKT26	173.163	
PKT27	171	06	23	0.87	323	17	4	248.883	248.995	-148.860	-0.019	199.598	-0.007	238462.737	2000824.034	PKT27	172.394	
PKT28	179	29	15	0.87	314	23	28	199.530	199.620	-142.644	-0.015	139.644	-0.005	238320.078	2000963.673	PKT28	172.123	
PKT29	197	53	43	0.87	313	52	44	159.153	159.224	-114.770	-0.012	110.364	-0.004	238205.296	2001074.032	PKT29	172.261	
BM005	151	58	13	0.87	331	46	28	24.858	24.869	-11.762	-0.002	21.912	-0.001	238193.532	2001095.944	BM005	172.331	
BM006	197	41	47	0.87	303	44	42	163.937	164.011	-136.378	-0.012	91.107	-0.004	238057.142	2001187.047	BM006	172.497	
BM007	161	30	56	0.87	321	26	29	236.379	236.485	-147.404	-0.018	184.925	-0.006	237909.720	2001371.965	BM007	172.910	
PKT30	190	43	54	0.87	303	9	26	57.196	57.222	-47.904	-0.004	31.297	-0.002	237861.812	2001403.260	PKT30	173.704	
PKT31	179	34	51	0.87	313	53	21	257.557	257.673	-185.700	-0.019	178.636	-0.007	237676.092	2001581.889	PKT31	172.001	
PKT32	180	49	10	0.87	313	28	13	252.187	252.300	-183.102	-0.019	173.577	-0.007	237492.972	2001755.460	PKT32	171.962	
PKT33	177	59	9	0.87	314	17	24	175.193	175.272	-125.462	-0.013	122.390	-0.005	237367.946	2001877.845	PKT33	171.674	
PKT34	165	08	13	0.87	312	16	34	206.261	206.354	-152.684	-0.015	138.815	-0.005	237214.797	2002016.654	PKT34	171.465	
PKT35	179	53	7	0.87	297	24	48	328.459	328.606	-291.707	-0.024	151.292	-0.009	236923.066	2002167.388	PKT35	172.217	
PKT36	185	15	9	0.87	297	17	55	246.850	246.961	-129.456	-0.018	113.264	-0.007	236703.592	2002281.195	PKT36	171.394	
BM008	206	21	50	0.87	302	33	5	220.264	220.363	-185.746	-0.016	118.568	-0.006	236517.829	2002399.757	BM008	172.217	
BM009	275	21	19	0.87	328	54	56	72.284	72.316	-37.337	-0.005	61.932	-0.002	236480.487	2002461.687	BM009	172.118	
PKT37	93	43	46	0.87	64	16	16	28.448	28.461	25.639	-0.002	12.355	-0.001	236506.124	2002474.042	PKT37	171.713	
PKT38	204	35	37	0.87	338	0	3	131.002	131.061	-49.095	-0.010	121.518	-0.003	236457.020	2002595.556	PKT38	172.257	
PKT39	180	47	25	0.87	2	35	41	253.812	253.926	11.495	-0.019	253.666	-0.007	236468.496	2002849.215	PKT39	172.726	
PKT40	180	30	23	0.87	3	23	7	202.539	202.630	11.965	-0.015	202.276	-0.005	236480.446	2003051.486	PKT40	173.388	
PKT41	179	48	5	0.87	303	53	43	238.369	238.476	-161.886	-0.018	237.926	-0.006	236496.634	2003289.406	PKT41	172.918	
PKT42	173	11	36	0.87	3	41	36	246.662	246.771	15.897	-0.018	246.260	-0.007	236512.493	2003355.659	PKT42	173.038	
BM010	171	50	39	0.87	356	53	13	159.883	159.955	-8.686	-0.012	159.719	-0.004	236503.794	2003695.374	BM010	174.318	
BM011	148	30	28	0.87	348	43	53	61.285	61.313	-11.981	-0.005	60.131	-0.002	236491.809	2003755.503	BM011	173.416	
PKT43	228	42	26	0.87	317	14	22	40.709	40.727	-27.651	-0.003	29.902	-0.001	236464.155	2003785.404	PKT43	173.550	
PKT44	159	13	27	0.87	5	56	49	49.746	49.768	5.156	-0.004	49.500	-0.001	236469.307	2003834.903	PKT44	172.801	
PKT45	174	51	22	0.87	345	10	17	181.027	181.108	-46.351	-0.013	175.077	-0.005	236422.943	2004009.974	PKT45	173.189	
PKT46	185	00	22	0.87	340	1	40	120.932	120.98									

Project :
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Checked :

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Instrument :
Approved :

OPEN TRAVERSE COMPUTING SHEET

Station	Observed Angle (A)			comp.	Forward Bearing (v)			H.Dist. (d)	Grid Dist. (D)	DY/DE d.sin(v)	comp.	DX/DN d.cos(v)	comp.	Co-ordinates		Station No.	Elevation
	o	'	"		o	'	"							m	m		
GPS03									(d * K)					235717.978	2008483.165	GPS03	180.464
GPS04	161	38	30		3	56	30	120.933						235726.291	2008603.812	GPS04	179.256
PKT69	184	27	50	0.40	345	35	0	50.852	50.876	-12.667	-0.003	49.274	-0.001	235713.621	2008653.085	PKT69	179.082
PKT70	181	00	30	0.40	350	2	51	146.379	146.448	-25.311	-0.009	144.244	-0.002	235688.302	2008797.327	PKT70	179.511
PKT71	180	05	27	0.40	351	3	21	169.001	169.081	-26.287	-0.010	167.025	-0.003	235662.004	2008964.349	PKT71	182.087
PKT72	174	12	19	0.40	351	8	48	202.095	202.190	-31.118	-0.012	199.782	-0.003	235630.875	2009164.127	PKT72	184.841
PKT73	196	01	28	0.40	345	21	8	116.225	116.280	-29.404	-0.007	112.501	-0.002	235601.463	2009276.626	PKT73	183.620
PKT74	179	59	47	0.40	1	22	36	239.887	240.000	5.766	-0.014	239.931	-0.004	235607.215	2009516.553	PKT74	179.211
PKT75	179	48	7	0.40	1	22	24	157.488	157.562	3.776	-0.009	157.517	-0.003	235610.982	2009674.067	PKT75	178.672
PKT76	181	14	23	0.40	1	10	31	222.121	222.226	4.558	-0.013	222.179	-0.004	235615.527	2009896.243	PKT76	182.852
PKT77	182	02	46	0.40	2	24	54	130.959	131.021	5.521	-0.008	130.904	-0.002	235621.040	2010027.145	PKT77	180.680
PKT78	100	57	11	0.40	4	27	41	244.283	244.398	19.011	-0.015	243.658	-0.004	235640.037	2010270.799	PKT78	179.958
BM016	268	07	51	0.40	285	24	52	26.571	26.584	-25.627	-0.002	7.066	0.000	235614.408	2010277.864	BM016	179.182
BM017	160	36	11	0.40	13	32	44	146.186	146.255	34.255	-0.009	142.187	-0.002	235648.655	2010420.049	BM017	178.257
PKT79	186	58	39	0.40	354	8	55	55.771	55.797	-5.688	-0.003	55.507	-0.001	235642.963	2010475.554	PKT79	177.514
PKT80	179	31	43	0.40	1	7	34	183.866	183.473	3.606	-0.011	183.437	-0.003	235646.558	2010658.988	PKT80	174.798
PKT81	181	29	25	0.40	0	39	18	235.922	236.033	2.698	-0.014	236.018	-0.004	235649.242	2010895.027	PKT81	175.667
PKT82	179	03	0	0.40	2	8	43	161.926	162.002	6.665	-0.010	161.889	-0.003	235655.297	2011056.889	PKT82	176.866
PKT83	179	54	33	0.40	1	11	44	219.417	219.521	4.580	-0.013	219.473	-0.004	235659.864	2011276.358	PKT83	175.096
PKT84	179	48	21	0.40	1	6	17	238.658	238.771	4.604	-0.014	238.726	-0.004	235664.543	2011515.080	PKT84	173.735
PKT85	179	58	48	0.40	0	54	38	194.051	194.143	3.086	-0.012	194.118	-0.003	235667.528	2011709.195	PKT85	177.639
PKT86	180	31	33	0.40	0	53	27	217.109	217.212	3.377	-0.013	217.185	-0.004	235670.892	2011926.337	PKT86	172.467
PKT87	170	49	20	0.40	1	25	0	126.741	126.801	3.155	-0.008	126.762	-0.002	235674.019	2012053.177	PKT87	172.055
PKT88	197	12	12	0.40	352	14	21	81.601	81.640	-11.025	-0.005	80.892	-0.001	235662.990	2012134.027	PKT88	172.805
PKT89	162	19	51	0.40	9	26	33	74.403	74.438	12.212	-0.004	73.430	-0.001	235675.197	2012207.455	PKT89	173.973
PKT90	191	30	22	0.40	351	46	24	88.220	88.262	-12.629	-0.005	87.353	-0.001	235662.563	2012294.807	PKT90	175.988
PKT91	176	40	1	0.40	3	16	47	95.026	95.071	5.439	-0.006	94.915	-0.002	235667.996	2012389.721	PKT91	174.423
BM018	138	04	13	0.40	359	56	48	129.286	129.347	-0.120	-0.008	129.347	-0.002	235667.868	2012519.066	BM018	173.056
BM019	202	48	57	0.40	318	1	2	227.474	227.581	-152.231	-0.014	169.171	-0.004	235515.624	2012688.233	BM019	172.891
PKT92	158	34	10	0.40	340	49	59	52.717	52.742	-17.316	-0.003	49.818	-0.001	235498.304	2012738.051	PKT92	172.427
PKT93	221	28	38	0.40	319	24	9	155.054	155.127	-100.947	-0.009	117.788	-0.003	235397.348	2012855.836	PKT93	171.832
PKT94	179	51	49	0.40	0	52	48	214.630	214.731	3.298	-0.013	214.706	-0.004	235400.633	2013070.539	PKT94	171.701
PKT95	180	23	37	0.40	0	44	37	164.334	164.412	2.134	-0.010	164.398	-0.003	235402.757	2013234.934	PKT95	171.721
PKT96	179	46	30	0.40	1	8	15	303.214	303.357	6.022	-0.018	303.297	-0.005	235408.760	2013533.226	PKT96	171.998
PKT97	175	20	20	0.40	0	54	45	223.934	224.040	3.568	-0.013	224.011	-0.004	235412.315	2013762.234	PKT97	172.321
PKT98	184	12	19	0.40	356	15	5	168.799	168.879	-11.041	-0.010	168.517	-0.003	235401.264	2013930.748	PKT98	172.026
PKT99	183	00	48	0.40	0	27	25	235.954	235.705	1.880	-0.014	235.698	-0.004	235403.130	2014166.442	PKT99	172.003
PKT100	150	25	48	0.40	3	28	13	248.956	249.074	15.077	-0.015	248.617	-0.004	235418.192	2014415.055	PKT100	171.460
BM020	209	20	1	0.40	333	54	2	63.972	64.002	-28.157	-0.004	57.476	-0.001	235390.031	2014472.530	BM020	171.495
BM021	180	43	8	0.40	3	14	3	94.602	94.647	5.340	-0.006	94.496	-0.002	235395.365	2014567.024	BM021	171.613
PKT101	176	37	11	0.40	3	57	11	207.607	207.705	14.319	-0.012	207.211	-0.003	235409.673	2014774.231	PKT101	171.554
PKT102	180	10	36	0.40	0	34	23	243.591	243.706	2.437	-0.014	243.694	-0.004	235412.095	2015017.921	PKT102	172.305
PKT103	179	59	21	0.40	0	44	59	198.965	199.059	2.605	-0.012	199.042	-0.003	235414.688	2015216.960	PKT103	171.945
PKT104	179	50	12	0.40	0	44	21	209.677	209.776	2.706	-0.012	209.759	-0.004	235417.382	2015426.715	PKT104	171.776
PKT105	179	40	3	0.40	0	34	33	193.736	193.827	1.948	-0.012	193.818	-0.003	235419.318	2015620.529	PKT105	172.246
PKT106	188	56	18	0.40	0	14	36	225.806	225.913	0.960	-0.013	225.911	-0.004	235420.265	2015846.436	PKT106	172.915
PKT107	163	28	41	0.40	9	10	55	117.902	117.958	18.822	-0.007	116.446	-0.002	235439.080	2015962.880	PKT107	172.899
PKT108	190	40	55	0.40	352	39	36	121.061	121.118	-15.474	-0.007	120.126	-0.002	235423.599	2016083.004	PKT108	172.643
PKT109	143	46	48	0.40	3	20	32	158.400	158.475	9.239	-0.009	158.205	-0.003	235432.828	2016241.207	PKT109	172.490
PKT110	188	42	0	0.40	327	7	20	105.209	105.259	-57.140	-0.006	88.399	-0.002	235375.683	2016329.604	PKT110	172.478
BM022	160	59	7	0.40	335	49	20	128.490	128.551	-52.650	-0.008	117.274	-0.002	235323.025	2016446.876	BM022	171.969
BM023	198	53	15	0.40	316	48	28	169.805	169.885	-116.278	-0.010	123.857	-0.003	235206.737	2016570.730	BM023	173.400
PKT111	167	56	57	0.40	335	41	43	134.830	134.894	-55.521	-0.008	122.938	-0.002	235151.208	2016693.666	PKT111	173.093
PKT112	186	17	43	0.40	323	38	41	303.198	303.341	-179.818	-0.018	244.297	-0.005	234971.372	2016937.958	PKT112	173.674
PKT113	180	22	59	0.40	329	56	24	245.369	245.485	-122.965	-0.015	212.467	-0.004	234848.392	2017150.421	PKT113	173.095
PKT114	187	21	20	0.40	330	19	23	257.147	257.268	-127.376	-0.015	223.523	-0.004	234721.001	2017373.904	PKT114	170.206
PKT115	172	04	59	0.40	337	40	44	294.776	294.915	-112.008	-0.018	272.817	-0.005	234608.976	2017646.752	PKT115	170.168
PKT116	189	42	5	0.40	329	45	43	144.984	145.052	-73.047	-0.009	125.317	-0.002	234535.920	2017772.067	PKT116	170.539
BM024	173	57	33	0.40	339	27	49	260.306	260.429	-91.360	-0.015	243.878	-0.004	234444.545	2018015.591	BM024	171.992
BM025	133	24	4	0.40	333	25	22	306.8									

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Station	Observed Angle (A)			co-mp.	Forward Bearing (v)			H.Dist. (d)	Grid Dist. (D)	DY/DE d.sin(v)	comp.	DX/DN d.cos(v)	comp.	Co-ordinates		station No.	Elevation				
	o	'	"		o	'	"							m	m			m	m	Y/E	X/N
														m	m						
GPS005															233111.994	2023302.362	GPS005	169.952			
GPS006															233017.973	2023424.571	GPS006	169.791			
PKT135	211	38	24	0.51	322	25	38	83.609	154.191	-8.646	0.002	83.203	0.003	233009.329	2023507.777	PKT135	170.453				
PKT136	176	39	28	0.51	335	24	58	280.013	280.152	-116.550	0.007	254.758	0.012	232892.787	2023762.546	PKT136	170.547				
PKT137	186	06	37	0.51	332	4	27	306.552	306.705	-143.638	0.008	270.990	0.013	232749.156	2024033.549	PKT137	170.821				
PKT138	173	45	18	0.51	338	11	4	249.241	249.365	-92.668	0.006	231.507	0.010	232656.494	2024265.066	PKT138	170.116				
PKT139	185	27	19	0.51	331	56	23	332.006	332.171	-156.253	0.008	293.126	0.014	232500.249	2024558.206	PKT139	170.667				
PKT140	174	40	38	0.51	337	23	42	258.537	258.666	-99.424	0.007	238.794	0.011	232400.831	2024797.011	PKT140	171.098				
PKT142	196	56	16	0.51	332	4	21	400.714	400.913	-187.769	0.010	354.223	0.016	232213.072	2025151.250	PKT142	171.371				
BM030	158	39	6	0.51	349	0	38	78.135	78.174	-14.902	0.002	76.740	0.003	232198.172	2025227.994	BM030	171.216				
BM031	192	15	19	0.51	327	39	44	210.168	210.273	-112.477	0.005	177.661	0.009	232085.700	2025405.664	BM031	172.894				
PKT143	169	30	31	0.51	339	55	4	156.032	156.110	-53.603	0.004	146.618	0.006	232032.101	2025552.289	PKT143	172.694				
PKT144	184	34	35	0.51	329	25	35	327.450	327.613	-166.639	0.008	282.067	0.013	231865.471	2025834.369	PKT144	172.048				
PKT145	175	03	4	0.51	334	0	11	329.986	330.150	-144.713	0.008	296.744	0.014	231720.766	2026131.127	PKT145	171.802				
PKT146	185	05	33	0.51	329	3	15	262.306	262.437	-134.952	0.007	225.080	0.011	231585.820	2026356.218	PKT146	172.645				
PKT147	174	50	48	0.51	334	8	49	336.298	336.465	-146.721	0.009	302.790	0.014	231439.108	2026509.022	PKT147	173.011				
PKT148	191	23	15	0.51	328	59	37	286.750	286.893	-147.788	0.007	245.899	0.012	231291.327	2026904.932	PKT148	172.331				
BM032	145	47	41	0.51	340	22	53	72.427	72.463	-24.330	0.002	68.256	0.003	231266.999	2026973.191	BM032	172.464				
BM033	197	19	3	0.51	306	10	34	133.541	133.607	-107.849	0.003	78.864	0.005	231159.153	2027052.061	BM033	172.305				
PKT149	170	39	32	0.51	323	29	38	168.072	168.156	-100.038	0.004	135.162	0.007	231059.120	2027187.230	PKT149	173.274				
PKT150	186	22	50	0.51	314	9	10	288.640	288.784	-207.198	0.007	201.159	0.012	230851.930	2027388.401	PKT150	173.039				
PKT151	171	57	1	0.51	320	32	1	207.602	207.705	-132.023	0.005	160.348	0.009	230719.912	2027548.758	PKT151	172.333				
PKT152	187	34	30	0.51	312	29	2	210.341	210.446	-155.197	0.005	142.131	0.009	230564.720	2027690.898	PKT152	180.598				
PKT153	175	29	34	0.51	320	3	33	220.116	220.226	-141.384	0.006	168.848	0.009	230423.342	2027859.755	PKT153	176.311				
PKT154	186	43	53	0.51	315	33	7	253.440	253.566	-177.563	0.006	181.017	0.010	230245.785	2028040.783	PKT154	174.510				
PKT155	171	39	52	0.51	322	17	1	285.977	286.119	-175.035	0.007	226.334	0.012	230070.758	2028267.129	PKT155	177.471				
PKT156	195	04	54	0.51	313	56	53	211.646	211.751	-152.454	0.005	146.957	0.009	229918.309	2028414.094	PKT156	177.113				
BM034	148	48	3	0.51	329	1	48	113.255	113.311	-58.309	0.003	97.157	0.005	229860.003	2028511.256	BM034	178.808				
BM035	215	07	41	0.51	297	49	51	74.622	74.659	-66.023	0.002	34.856	0.003	229793.981	2028546.115	BM035	176.798				
PKT157	163	26	5	0.51	332	57	33	68.646	68.680	-31.224	0.002	61.172	0.003	229762.759	2028607.290	PKT157	176.594				
PKT158	184	19	40	0.51	316	23	38	353.167	353.343	-243.699	0.009	255.855	0.015	229519.069	2028863.159	PKT158	176.918				
PKT159	177	00	46	0.51	320	43	19	289.143	289.287	-183.143	0.007	223.932	0.012	229335.933	2029087.103	PKT159	179.076				
PKT160	179	19	8	0.51	317	44	5	290.347	290.492	-195.374	0.007	214.975	0.012	229140.566	2029302.090	PKT160	178.733				
PKT161	180	19	15	0.51	317	3	14	288.764	288.908	-196.836	0.007	211.479	0.012	228943.738	2029513.581	PKT161	177.367				
PKT162	178	22	29	0.51	317	22	29	292.118	292.263	-197.921	0.007	215.047	0.012	228745.824	2029728.640	PKT162	177.674				
BM036	174	20	34	0.51	315	44	59	336.455	336.622	-234.894	0.009	241.122	0.014	228510.940	2029969.775	BM036	179.370				
BM037	165	11	18	0.51	310	5	33	60.791	60.821	-46.529	0.002	39.170	0.002	228464.412	2030008.948	BM037	179.790				
PKT163	197	21	53	0.51	295	16	52	123.211	123.272	-111.466	0.003	52.644	0.005	228352.950	2030061.598	PKT163	179.855				
PKT164	177	08	38	0.51	312	38	45	318.399	318.557	-234.316	0.008	215.812	0.013	228118.641	2030277.422	PKT164	183.225				
PKT165	208	50	25	0.51	309	47	24	253.421	253.547	-194.825	0.006	162.264	0.010	227923.823	2030439.697	PKT165	183.448				
PKT166	200	10	24	0.51	338	37	49	182.573	182.664	-66.560	0.005	170.106	0.008	227857.268	2030609.810	PKT166	184.665				
PKT167	184	33	39	0.51	358	48	14	89.813	89.858	-1.876	0.002	89.838	0.004	227855.395	2030699.651	PKT167	185.352				
PKT168	173	47	25	0.51	3	21	53	205.065	205.167	12.042	0.005	204.813	0.008	227867.442	2030904.473	PKT168	185.643				
PKT169	186	05	43	0.51	357	9	19	272.053	272.188	-13.509	0.007	271.853	0.011	227853.940	2031176.337	PKT169	183.085				
PKT170	173	39	20	0.51	3	15	2	278.096	278.234	15.777	0.007	277.787	0.011	227869.724	2031454.136	PKT170	184.819				
BM038	191	01	40	0.51	356	54	23	296.689	296.837	-16.020	0.008	296.404	0.012	227853.711	2031750.552	BM038	187.845				
BM039	143	20	4	0.51	7	56	3	177.489	177.577	24.512	0.005	175.877	0.007	227878.228	2031926.437	BM039	191.534				
PKT171	213	48	36	0.51	331	16	8	39.031	39.050	-18.772	0.001	34.243	0.002	227859.457	2031960.681	PKT171	193.083				
PKT172	173	43	53	0.51	5	4	44	240.176	240.296	21.273	0.006	239.352	0.010	227880.737	2032200.043	PKT172	200.830				
PKT173	185	50	56	0.51	358	48	38	419.998	420.207	-8.723	0.011	420.117	0.017	227872.024	2032620.177	PKT173	191.861				
PKT174	176	24	56	0.51	4	39	34	201.062	201.162	16.341	0.005	200.497	0.008	227888.371	2032820.682	PKT174	193.062				
PKT175	180	41	41	0.51	1	4	31	398.401	398.599	7.480	0.010	398.529	0.016	227895.860	2033219.228	PKT175	181.469				
PKT176	180	28	40	0.51	1	46	12	265.382	265.514	8.201	0.007	265.387	0.011	227904.069	2033484.626	PKT176	184.957				
PKT177	177	25	47	0.51	2	14	53	280.124	280.263	10.993	0.007	280.048	0.012	227915.069	2033764.685	PKT177	189.416				
PKT178	183	05	52	0.51	359	40	40	330.915	331.080	-1.861	0.008	331.074	0.014	227913.216	2034095.773	PKT178	178.298				
PKT179	195	02	17	0.51	2	46	33	231.467	231.582												

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OPEN TRAVERSE COMPUTING SHEET

	Observed Angle (A)			co-mp.	Forward Bearing (v)			H.Dist. (d)	Grid Dist. (D)	DY/DE d.sin(v)	comp.	DX/DN d.cos(v)	comp.	Co-ordinates		station No.	Elevation				
	o	'	"		o	'	"							m	m			m	m	Y/E	X/N
														m	m						
GPS007									(d * K)					228122.371	2037688.302	GPS007	182.873				
GPS008	148	43	30		11	32	37	112.041						228144.792	2037798.077	GPS008	182.044				
PKT190	204	55	26	-0.05	340	16	7	102.186	102.239	-34.517	0.001	96.236	0.000	228110.276	2037894.313	PKT190	183.044				
PKT191	175	31	42	-0.05	5	11	33	355.301	355.484	32.172	0.004	354.025	0.000	228142.452	2038248.338	PKT191	195.675				
PKT192	184	08	59	-0.05	0	43	15	249.773	249.901	3.144	0.003	249.882	0.000	228145.599	2038498.220	PKT192	201.211				
PKT193	174	45	19	-0.05	4	52	14	408.410	408.620	34.693	0.005	407.144	0.000	228180.296	2038905.364	PKT193	193.059				
PKT194	183	42	38	-0.05	359	37	33	270.258	270.397	-1.766	0.003	270.391	0.000	228178.533	2039175.756	PKT194	189.120				
PKT195	152	01	20	-0.05	3	20	11	205.009	205.114	11.937	0.002	204.767	0.000	228190.472	2039380.523	PKT195	192.097				
PKT196	160	34	43	-0.05	335	21	31	264.467	264.603	-110.323	0.003	240.507	0.000	228080.152	2039621.029	PKT196	191.724				
BM044	205	41	18	-0.05	315	56	13	130.058	130.125	-90.495	0.001	93.505	0.000	227989.659	2039714.534	BM044	191.272				
BM045	359	52	39	-0.05	341	37	31	105.963	106.017	-33.420	0.001	100.612	0.000	227956.240	2039815.146	BM045	186.773				
139	154	31	42	-0.05	161	30	10	105.723	105.777	33.559	0.001	-100.313	0.000	227989.800	2039714.834	139					
140	199	19	30	-0.05	136	1	52	130.229	130.296	90.460	0.001	-93.776	0.000	228080.261	2039621.057	140					
141	207	59	30	-0.05	155	21	22	264.491	264.627	-110.343	0.003	-240.524	0.000	228190.608	2039380.534	141					
142	176	15	58	-0.05	183	20	52	205.085	205.190	-11.983	0.002	-204.840	0.000	228178.627	2039175.694	142					
143	185	15	48	-0.05	179	36	50	270.216	270.355	1.822	0.003	-270.349	0.000	228180.452	2038905.345	143					
144	175	50	33	-0.05	184	52	38	408.427	408.637	-34.743	0.005	-407.157	0.000	228145.714	2038498.188	144					
145	184	28	28	-0.05	180	43	11	249.735	249.863	-3.139	0.003	-249.844	0.000	228142.578	2038248.345	145					
146	155	08	11	-0.05	185	11	39	355.327	355.510	-12.185	0.004	-354.050	0.000	228110.398	2037894.295	146					
GPS008	211	12	47	-0.05	160	19	50	102.128	102.180	34.393	0.001	-96.218	0.000	228144.792	2037798.077	GPS008					
										DY		DX									
										0.000		0.000		228144.792	2037798.077	GPS008	182.044				
														228122.371	2037688.302	GPS007	182.873				
CLOSING ERROR FOR CO-ORDINATES														REJECTION LIMITS							
n =	19	10.SQRT(n) =			43.6 *	1 : 10.000			0.0001			m		Class 3 and Order 1							
Sum=	3600	0	1	+	11	32	37	d	D	-0.048	dY	-0.003	dX	Closing Ratio		Closing for Bearing =10.SQRT(n) *					
(180 * n)	3420	=			191	32	38	4182.786	4184.936	0.048	DY-DY	0.003	DX-dX	86698.256		Closing for Co-ord. = 1 : 10.000					
Misclose	0	0	1		-1 *			SQRT(DY ² +DX ²) =			0.048		m		n : number of instrument stations						
Status	OK							SQRT(DY ² +DX ²) / D =			0.00001		m		d : sum of all distances in traverse (m)						
								Status			OK				K = 1.0005139143						

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	Observed Angle (A)			co-mp.	Forward Bearing (v)			H.Dist. (d)	Grid Dist. (D)	DY/DE d.sin(v)	comp.	DX/DN d.cos(v)	comp.	Co-ordinates		station No.	Elevation				
	o	'	"		o	'	"							m	m			m	m	Y/E	X/N
														m	m						
BM044									(d * K)					227989.659	2039714.534	BM044	191.272				
BM045	148	46	59		341	37	34	106.017						227956.240	2039815.146	BM045	186.773				
PKT197	167	58	5	-0.48	310	24	32	284.341	284.487	-216.619	-0.001	184.416	-0.003	227739.620	2039999.560	PKT197	185.770				
PKT198	168	22	21	-0.48	298	22	37	309.983	310.142	-272.876	-0.002	147.401	-0.003	227466.742	2040146.958	PKT198	195.255				
PKT199	186	48	8	-0.48	286	44	57	234.810	234.931	-224.964	-0.001	67.703	-0.002	227241.777	2040214.659	PKT199	200.100				
PKT200	193	37	3	-0.48	293	33	5	421.566	421.783	-386.649	-0.002	168.532	-0.004	226855.126	2040383.187	PKT200	189.622				
PKT201	193	56	38	-0.48	307	10	7	272.975	273.115	-217.635	-0.001	165.007	-0.003	226637.490	2040548.192	PKT201	191.403				
PKT202	194	32	59	-0.48	321	6	45	131.894	131.962	-82.845	-0.001	102.716	-0.001	226554.645	2040650.907	PKT202	193.172				
PKT203	197	54	58	-0.48	335	39	44	153.145	153.224	-63.146	-0.001	139.607	-0.001	226491.498	2040790.512	PKT203	188.964				
PKT204	226	40	49	-0.48	353	34	41	241.771	241.895	-27.056	-0.001	240.377	-0.002	226464.441	2041030.887	PKT204	181.531				
BM046	128	04	29	-0.48	40	15	30	40.309	40.330	26.062	0.000	30.777	0.000	226490.503	2041061.664	BM046	181.925				
BM047	359	50	50	-0.48	348	19	58	116.252	116.312	-23.521	-0.001	113.909	-0.001	226466.981	2041175.572	BM047	179.098				
130	232	15	48	-0.48	168	10	48	116.326	116.386	23.840	-0.001	-113.918	-0.001	226490.821	2041061.653	130					
131	133	07	52	-0.48	220	26	35	40.473	40.494	-26.268	0.000	-30.818	0.000	226464.553	2041030.834	131					
132	162	05	20	-0.48	173	34	27	241.724	241.848	27.067	-0.001	-240.329	-0.002	226491.619	2040790.503	132					
133	165	25	40	-0.48	155	39	46	153.103	153.182	63.127	-0.001	-139.569	-0.001	226554.745	2040650.933	133					
134	166	04	35	-0.48	141	5	26	131.864	131.932	82.865	-0.001	-102.661	-0.001	226637.610	2040548.270	134					
135	166	23	6	-0.48	127	10	0	272.953	273.093	217.623	-0.001	-164.986	-0.003	226855.231	2040383.282	135					
136	173	11	34	-0.48	113	33	6	421.525	421.742	386.611	-0.002	-168.517	-0.004	227241.840	2040214.761	136					
137	191	38	3	-0.48	106	44	39	234.811	234.932	224.971	-0.001	-67.684	-0.002	227466.809	2040147.075	137					
138	192	03	20	-0.48	118	22	42	310.033	310.192	272.916	-0.002	-147.432	-0.003	227739.723	2039999.640	138					
BM045	211	11	33	-0.48	130	26	1	284.313	284.459	216.518	-0.001	-184.491	-0.003	227956.240	2039815.146	BM045					
										DY		DX									
										0.000		0.000		227956.240	2039815.146	BM045	186.773				
														227989.659	2039714.534	BM044	191.272				
CLOSING ERROR FOR CO-ORDINATES														REJECTION LIMITS							
n =	21	10.SQRT(n) =			45.8 *	1 : 10.000			0.0001			m		Class 3 and Order 1							
Sum=	3960	0	10	+	341	37	34	d	D	0.023	dY	0.041	dX	Closing Ratio		Closing for Bearing =10.SQRT(n) *					
(180 * n)	3780	=			161	37	44	4414.171	4416.440	-0.023	DY-DY	-0.041	DX-dX	93606.108		Closing for Co-ord. = 1 : 10.000					
Misclose	0	0	10		-10 *			SQRT(DY ² +DX ²) =			0.047		m		n : number of instrument stations						
Status	OK							SQRT(DY ² +DX ²) / D =			0.00001		m		d : sum of all distances in traverse (m)						
								Status			OK				K = 1.0005139143						

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	Observed Angle (A)			co-mp.	Forward Bearing (v)			H.Dist. (d)	Grid Dist. (D)	DY/DE d.sin(v)	comp.	DX/DN d.cos(v)	comp.	Co-ordinates		station No.	Elevation				
	o	'	"		o	'	"							m	m			m	m	Y/E	X/N
														m	m						
BM046													226490.503	2041061.664	BM046	181.925					
BM047	207	02	47		348	19	57	116.311						226466.981	2041175.572	BM047	179.098				
PKT205	155	53	51	1.35	15	22	45	76.891	76.931	20.402	-0.002	74.176	0.000	226487.382	2041249.748	PKT205	179.589				
PKT206	181	22	18	1.35	351	16	37	202.917	203.021	-30.789	-0.006	200.673	0.000	226456.587	2041450.421	PKT206	185.241				
PKT207	202	51	21	1.35	352	38	57	264.594	264.730	-33.871	-0.007	262.554	0.000	226422.708	2041712.976	PKT207	184.183				
PKT208	181	43	39	1.35	15	30	19	406.292	406.501	108.669	-0.011	391.706	0.001	226531.367	2042104.683	PKT208	182.816				
PKT209	151	48	42	1.35	17	13	60	224.286	224.401	66.481	-0.006	214.327	0.000	226597.842	2042319.010	PKT209	183.931				
PKT210	169	54	39	1.35	349	2	43	184.860	184.955	-35.148	-0.005	181.585	0.000	226562.689	2042500.595	PKT210	183.095				
PKT211	202	37	46	1.35	338	57	23	231.622	231.741	-83.213	-0.006	216.286	0.000	226479.470	2042716.882	PKT211	183.258				
BM048	154	39	17	1.35	1	35	11	62.593	62.625	1.734	-0.002	62.601	0.000	226481.202	2042779.483	BM048	184.923				
BM049	214	31	3	1.35	336	14	29	98.767	98.818	-39.812	-0.003	90.443	0.000	226441.387	2042869.926	BM049	188.058				
PKT212	158	07	21	1.35	10	45	33	113.003	113.061	21.107	-0.003	111.073	0.000	226462.491	2042981.000	PKT212	185.438				
PKT213	204	56	40	1.35	348	52	56	370.785	370.976	-71.534	-0.010	364.013	0.001	226390.946	2043345.014	PKT213	180.121				
PKT214	183	30	34	1.35	13	49	37	200.722	200.825	47.995	-0.005	195.006	0.000	226438.936	2043540.020	PKT214	182.459				
PKT215	167	20	48	1.35	17	20	12	226.794	226.911	67.617	-0.006	216.602	0.000	226506.546	2043756.622	PKT215	180.887				
BM050	199	30	16	1.35	4	41	2	137.811	137.882	11.259	-0.004	137.421	0.000	226517.802	2043894.044	BM050	180.107				
BM051	359	31	42	1.35	24	11	19	68.364	68.399	28.026	-0.002	62.394	0.000	226545.826	2043956.438	BM051	180.766				
116	161	10	40	1.35	203	43	2	68.015	68.050	-27.371	-0.002	-62.303	0.000	226518.452	2043894.135	116					
117	192	26	14	1.35	184	53	44	137.985	138.056	-11.782	-0.004	-137.552	0.000	226506.667	2043756.583	117					
118	176	29	34	1.35	197	19	59	226.826	226.943	-67.612	-0.006	-216.637	0.000	226439.049	2043539.947	118					
119	155	02	59	1.35	193	49	35	200.689	200.792	-47.985	-0.005	-194.974	0.000	226391.058	2043344.973	119					
120	201	51	13	1.35	168	52	35	370.735	370.926	71.562	-0.010	-363.957	0.001	226462.610	2042981.017	120					
121	145	28	36	1.35	190	43	49	113.107	113.165	-21.070	-0.003	-111.186	0.000	226441.537	2042869.830	121					
122	205	26	24	1.35	156	12	27	98.718	98.769	39.846	-0.003	-90.375	0.000	226481.380	2042779.456	122					
123	157	18	19	1.35	181	38	52	62.535	62.567	-1.799	-0.002	-62.541	0.000	226479.580	2042716.915	123					
124	190	05	14	1.35	158	57	12	231.591	231.710	83.213	-0.006	-216.252	0.000	226562.787	2042500.663	124					
125	208	11	25	1.35	169	2	28	184.920	185.015	35.173	-0.005	-181.641	0.000	226597.954	2042319.022	125					
126	178	15	55	1.35	197	13	54	224.362	224.477	-66.498	-0.006	-214.402	0.000	226531.450	2042104.621	126					
127	157	09	0	1.35	195	29	50	406.253	406.462	-108.604	-0.011	-391.684	0.001	226422.835	2041712.938	127					
128	178	37	11	1.35	172	38	52	264.568	264.704	33.874	-0.007	-262.528	0.000	226456.702	2041450.411	128					
129	204	12	22	1.35	171	16	4	202.914	203.018	30.822	-0.006	-200.665	0.000	226487.518	2041249.746	129					
BM047	152	51	28	1.35	195	28	27	76.925	76.965	-20.535	-0.002	-74.175	0.000	226466.981	2041175.572	BM047					
										DY		DX									
										0.000		0.000		226466.981	2041175.572	BM047	179.098				
														226490.503	2041061.664	BM046	181.925				
					168	19	57														
CLOSING ERROR FOR CO-ORDINATES														REJECTION LIMITS							
n =	31	10.SQRT(n) =			55.7 "			1 : 10.000			0.0001			m				Class 3 and Order 1			
Sum=	5759	59	18	+	348	19	57	d	D	0.156	dY	-0.010	dX	Closing Ratio	Closing for Bearing = 10.SQRT(n) "						
(180 * n)	5580			=	168	19	15	5740.444	5743.394	-0.156	DY-dY	0.010	DX-dX	36822.444	Closing for Co-ord. = 1 : 10.000						
Misclose	0	0	42		42 "			SQRT(DY ² +DX ²) =			0.156			m			n : number of instrument stations				
Status	OK							SQRT(DY ² +DX ²) / D =			0.00003			m		d : sum of all distances in traverse (m)					
								Status			OK			K =		1.0005139143					

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	o	'	"		o	'	"							m	m			m	m	Y/E	X/N	
	(d * K)													m	m							
BM050														226517.802	2043894.044	BM050	180.107					
BM051	155	00	42		24	11	14		68.398					226545.826	2043956.438	BM051	180.766					
PKT216	203	50	36	1.00	359	11	57	247.231	247.358	-3.458	0.003	247.334	0.000	226542.371	2044203.771	PKT216	188.653					
PKT217	157	51	57	1.00	23	2	34	179.692	179.784	70.371	0.002	165.440	0.000	226612.743	2044369.211	PKT217	200.271					
PKT218	175	09	12	1.00	0	54	32	150.040	150.117	2.381	0.002	150.098	0.000	226615.126	2044519.309	PKT218	201.269					
PKT219	192	26	49	1.00	356	3	45	344.931	345.108	-23.699	0.004	344.294	0.000	226591.431	2044863.603	PKT219	198.636					
PKT220	178	41	9	1.00	8	30	35	105.219	105.273	15.578	0.001	104.114	0.000	226607.010	2044967.717	PKT220	193.539					
PKT221	187	10	3	1.00	7	11	45	82.142	82.184	10.294	0.001	81.537	0.000	226617.305	2045049.253	PKT221	186.876					
PKT222	172	57	41	1.00	14	21	49	364.078	364.265	90.364	0.004	352.879	0.000	226707.673	2045402.132	PKT222	176.814					
PKT223	186	31	29	1.00	7	19	31	228.611	228.728	29.163	0.002	226.862	0.000	226736.838	2045628.993	PKT223	178.260					
BM052	164	21	8	1.00	13	51	1	279.736	279.880	66.999	0.003	271.742	0.000	226803.840	2045900.735	BM052	177.683					
BM053	190	27	46	1.00	358	12	10	105.472	105.526	-3.310	0.001	105.474	0.000	226800.531	2046006.210	BM053	178.738					
PKT224	164	51	19	1.00	8	39	57	121.111	121.173	18.257	0.001	119.790	0.000	226818.790	2046125.999	PKT224	178.978					
PKT225	192	10	10	1.00	353	31	17	228.838	228.956	-25.834	0.002	227.493	0.000	226792.958	2046353.493	PKT225	182.421					
PKT226	168	21	49	1.00	5	41	28	85.397	85.441	8.473	0.001	85.020	0.000	226801.432	2046438.512	PKT226	182.311					
PKT227	226	06	34	1.00	354	3	18	162.322	162.405	-16.821	0.002	161.532	0.000	226784.612	2046600.044	PKT227	181.010					
PKT228	173	20	57	1.00	40	9	53	437.232	437.457	282.153	0.005	334.302	0.000	227066.710	2046934.346	PKT228	178.830					
BM054	148	12	36	1.00	33	30	51	197.280	197.381	108.982	0.002	164.567	0.000	227175.755	2047098.912	BM054	177.368					
BM055	359	34	52	1.00	1	43	28	67.589	67.624	2.035	0.001	67.593	0.000	227177.790	2047166.505	BM055	178.110					
100	212	18	9	1.00	181	18	21	67.516	67.551	-1.539	0.001	-67.533	0.000	227176.252	2047098.972	100						
101	186	32	58	1.00	213	36	31	197.616	197.718	-109.440	0.002	-164.667	0.000	227066.814	2046934.305	101						
102	133	53	50	1.00	220	9	30	437.221	437.446	-282.109	0.005	-334.325	0.000	226784.710	2046599.980	102						
103	191	38	1	1.00	174	3	21	162.235	162.318	16.810	0.002	-161.446	0.000	226801.521	2046438.534	103						
104	167	49	45	1.00	185	41	23	85.445	85.489	-8.475	0.001	-85.068	0.000	226793.047	2046353.466	104						
105	195	05	23	1.00	173	31	9	228.800	228.918	25.839	0.002	-227.455	0.000	226818.888	2046126.011	105						
106	169	40	33	1.00	188	36	33	121.114	121.176	-18.139	0.001	-119.811	0.000	226800.750	2046006.200	106						
107	195	33	49	1.00	178	17	7	105.476	105.530	3.158	0.001	-105.483	0.000	226803.909	2045900.717	107						
108	173	28	35	1.00	193	50	57	279.760	279.904	-66.999	0.003	-271.767	0.000	226736.913	2045628.950	108						
109	187	02	31	1.00	187	19	33	228.600	228.717	-29.164	0.002	-226.851	0.000	226707.752	2045402.099	109						
110	172	48	18	1.00	194	22	5	364.095	364.282	-90.396	0.004	-352.888	0.000	226617.359	2045049.211	110						
111	180	54	52	1.00	187	10	24	82.123	82.165	-10.260	0.001	-81.522	0.000	226607.100	2044967.689	111						
112	168	06	27	1.00	188	5	17	105.202	105.256	-14.809	0.001	-104.209	0.000	226592.293	2044863.480	112						
113	184	41	57	1.00	176	11	45	344.825	345.002	22.890	0.004	-344.242	0.000	226615.187	2044519.237	113						
114	202	08	25	1.00	180	53	43	149.951	150.028	-2.344	0.002	-150.010	0.000	226612.844	2044369.227	114						
115	156	11	13	1.00	203	2	9	179.759	179.851	-70.377	0.002	-165.510	0.000	226542.469	2044203.717	115						
BM051	204	57	50	1.00	179	13	23	247.175	247.302	3.354	0.003	-247.279	0.000	226545.826	2043956.438	BM051						
										DY		DX										
										0.000		0.000		226545.826	2043956.438	BM051	180.766					
														226517.802	2043894.044	BM050	180.107					
CLOSING ERROR FOR CO-ORDINATES														REJECTION LIMITS								
n =	35	10.SQRT(n) =			59.2 "			1 : 10.000			0.0001			m			Class 3 and Order 1					
Sum=	6479	59	25	+	24	11	14	d	D	-0.071	dY	0.006	dX	Closing Ratio	Closing for Bearing = 10.SQRT(n) "							
(°180 * n)	6300			=	204	10	39	6773.834	6777.315	0.071	DY-dY	-0.006	DX-dX	94783.131	Closing for Co-ord. = 1 : 10.000							
Misclose	0	0	35		35 "			SQRT(DY^2+DX^2) =			0.072			m			n : number of instrument stations					
Status	OK												SQRT(DY^2+DX^2) / D =			0.00001			m		d : sum of all distances in traverse (m)	
													Status			OK			K =		1.0005139143	