参考資料１　2014.3.4 現地セミナー（第 1 回）

日　時：	2014 年 3 月 4 日（火）9:30～14:00
場　所：	Century Atlet Hotel、 8F Conference Room
出席者：	DKI Jakarta Hassan Basli 知事補官のキーノートスピーチ
	官側：CIPTA KARYA、PD PAL Jaya、Dinas PU Jakarta
	建設会社、コンクリート二次製品工場、ローカルコンサルタント
	日本のコンサルタント（MRT 関係者）
	全員で、50 名程度

【セミナープログラム・概要】

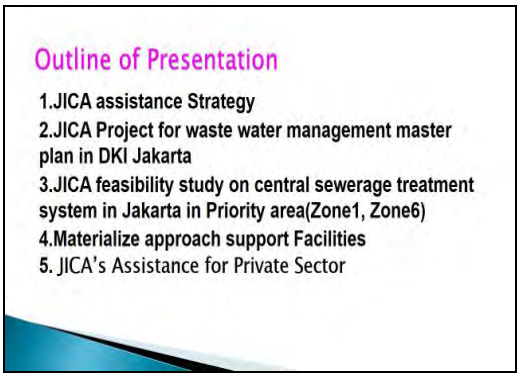
プログラム名	登壇者	発表内容
1）基調講演-1	Mr. Hassan Basri （DKI Jakarta）	ジャカルタでの下水道の必要性、推進技術の必要性など
2）基調講演-2	富原　崇之 （JICA インドネシア事務所）	インドネシア国における日本の ODA 事業、ジャカルタ下水道事業への JICA の取り組みなど
3）プレゼンテーション-1	井上団員 （日本工営）	ジャカルタ下水道事業の紹介
4）プレゼンテーション-2	平井団員・佐々木団員 （イセキ開発工機）	イセキ開発工機の推進技術の紹介
5）中締め	中島専門家 （JICA：CIPTA KARYA）	ジャカルタでの下水道の必要性及び本邦推進技術の必要性とメリット
6）質疑応答	脇田団員 （イセキ開発工機）	主に推進工法の技術面に関して多数の質問があった（巻末参考資料-3 に記載）。
7）閉会挨拶		パイロットプロジェクトの今後のスケジュール等の説明

【セミナー内容】

1. 基調講演-1：Mr. Hassan Basri（DKI Jakarta）

- ジャカルタは、トンネル技術を必要としている。On-site 処理、Off-site 処理で下水処理計画を進めている。Zone-1&2 下水処理区の事業化を考えている。下水道の普及率が 25%以下であるので、推進工法による下水道整備が必要である。
- 推進工法は、Jl. Sudirman 横断 300m、Ciliwung －Bajir Kana Timur バイパスプロジェクトで進めている。

2. 基調講演-2：富原企画調査員（JICA インドネシア事務所）



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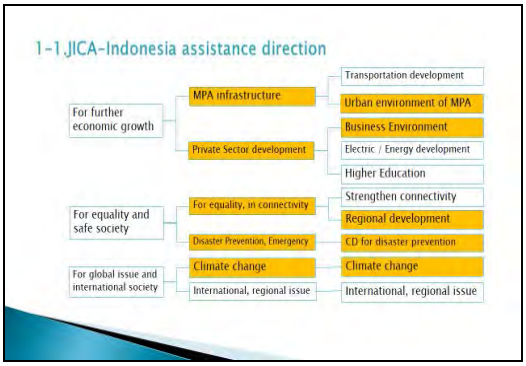
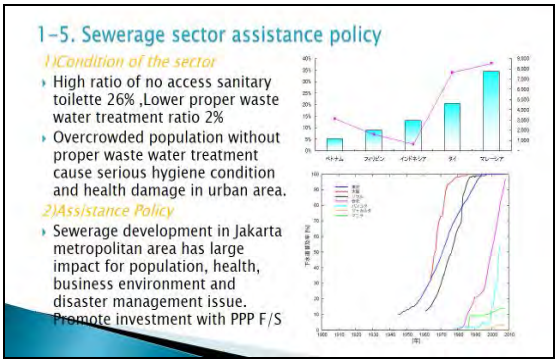
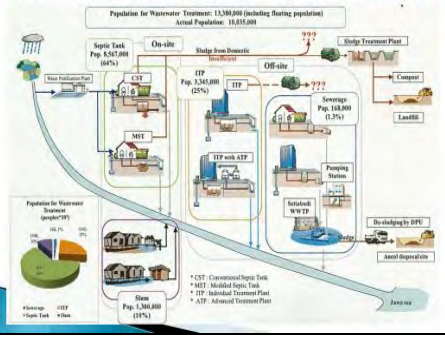




2.JICA Project for waste water management master plan in DKI Jakarta

2-1.Present Condition of Sewerage treatment in DKI Jakarta



2-2.Target of Master Plan

Table S2-1 Improvement Targets for Wastewater Management in DKI Jakarta

	Item	Unit	Short-term Plan			Medium-term Plan	Long-term Plan
			Y2012	Y2014	Y2020	Y2030	Y2050
	Design Population	1,000PE	12,665	12,665	12,665	12,665	12,665
	Administration Population	1,000PE	10,035	10,361	11,284	12,665	12,665
Off-site	Facility Coverage Ratio	%	2	7	20	40	80
Off-site	Service Coverage Ratio	%	2	4	15	35	80
Off-site	*Served Population*	*1,000PE*	*168*	*387*	*1,685*	*4,478*	*10,166*
On-site	On-site Treatment Ratio	%	85	96	85	65	20
On-site	*Served Population for On-site*	*1,000PE*	*8,567*	*9,974*	*9,599*	*8,188*	*2,500*
On-site	*Regular Desludging Coverage ratio*	%	*0*	*20*	*50*	*75*	*100*
On-site	*Change CST to MST (MST/(CST+MST))*	%	*2*	*16*	*25*	*30*	*100*
Slum area	Open Defecation Ratio	%	13	0	0	0	0
Slum area	*Open Defecation Population*	*1,000PE*	*1,300*	*0*	*0*	*0*	*0*
	River Water Quality (BOD)	mg/L	61	54	33	24	10

2-3.off site sewerage system

	Area	Average m3/day	Maximum M3/day
Short Term	1	198,000	264,000
	6	235,000	313,000
Mid term	4,5,8,10	47000-248000	62000-331000
Long term	others	24000-253000	32000-337000
Total		1977000	2636000

	Area (ha)	2,3rd Sewer(m)	Sewer Main(m)	Pump
Short	10,775	1485951	240878	1
Mid	15,301	2043273	470962	3
Long	37,328	4741416	1203205	9
Total	63,404	8270641	1915044	13

Figure S3-2 Layout Plan for Main Sewerage Facilities in Each Sewerage Zone

2-4.On site system

1)Concept

- 80% population will connect to sewerage system by 2050
- Following countermeasure will be required to minimize worse influence of on-site system (septic tank)

2)Improvement Plan

- On-call sludge removal ⇒DKI regularly removal
- Domestic water except night soil directly flow in river
  ⇒Replace "conventional " to " modified" septic tank
- Individual treatment plant not proper managed and not satisfied drainage water standard
  ⇒Strengthen proper management of ITP

3)Improvement plan of sludge treatment plant

<Estimation of sludge treatment amount >

M3/day	2012	2020	2030	2040	2050
Sludge	257	2370	3887	3229	1000
Treatment Plant	600	1050	600	600	600
Treatment in WWTP	0	1320	3287	2329	400

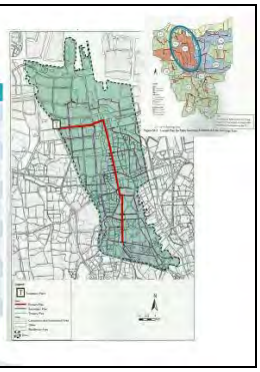
<Treatment facility improvement plan>

Sludge treatment plant (existence, improvement)	-Integrate Dori Kosambi to new treatment plant 950m3/day -Expand and rehabilitation Pulo Geban STP 450m3/day -Integrate Pulo Geban STP to new treatment plant 940m3/day
New treatment plant In south DKI	New treatment plant development 600m3/day
Treatment in WWTP	-No1WWTP up to 790m3/day -No5 WWTP up to 410m3/day -No8 WWTP up to 570m3/day

2-5.Priority project

1)Off site System

Item	unit	No1
Area	ha	4,901
Planned Population	PE	1,236,736
Spared ratio	%	80
Spread Population	PE	989,389
Average volume	M3/day	198,000
Maximum volume	M3/day	264,000
2nd 3rd pipe(200-300mm)	km	657
Main sewer(350-800mm)	km	86
Trunk sewer(900-2200mm)	km	15.5
Pomp station		
WWTP	M3/day	264,000



Item	unit	No6
Area	ha	5,874
Planned Population	PE	1,465,718
Spared ratio	%	80
Spread Population	PE	1,172,574
Average volume	M3/day	235,000
Maximum volume	M3/day	313,000
2nd 3rd pipe(200-300mm)	km	829
Main sewer(350-800mm)	km	155
Trunk sewer(900-2200mm)	km	24
Pomp station	M3/min	1(172)
WWTP	M3/day	313,000

参考 3

2)On site system

- Rehabilitation and expansion of existing treatment plant
  - -Integrate Dori Kosambi to new treatment plant 950m3/day
  - -Expand and rehabilitation Pulo Geban STP 450m3/day
- New treatment plant development
  - -600m3/day in south DKI
  - -Require 1.5ha
- Treatment in WWTP
  - -No1WWTP up to 790m3/day

Rehabilitation of existing plant

New treatment Plant

Treatment in WWTP

3)Project cost estimation

million IDR

Items	Initial cost	Replacement cost (2013-50)	Total
Short term	12656397	2606758	6271565
Zone1	5324219	1147840	6472059
Sewerage	5192315	1079250	6271565
On site	131904	68590	200494
Zone6	7265688	1438644	8704331
Sewerage	7110408	1357898	8468307
On site	155279	80745	236025
Sludge treatment plant	66490	20275	62375
Mid term (4,5,8,10)	17040187	2822798	19862985
Long term (others)	34357286	144858	34502144
Grand total	64053869	5574415	69628284

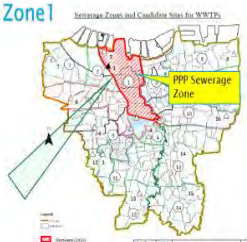
3. JICA Feasibility study on central sewerage treatment system in Priority Area (Zone1,6)

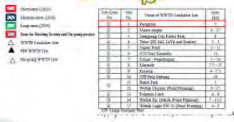
3-1.Preparatory survey in Zone1

1)Project Outline

Zone1:

- Sewerage Area 4,901 ha
- Served Population 1,137,853 people
- STP Capacity 264,000 m^3/day
- Total Cost 4,384,000 juta Rp
  - STP 1,600,000 juta Rp
  - Sewers 2,784,000 juta Rp





2) Concept of Step-wised Sewer Development

Trunk main sewer - Main Sewer - House connection (with area redevelopment)

Combined system - Separate System

First stage (approx. year 1 to 10)

→ Main Sewer & Existing Drainage

Outcome (1) : Rapid Increase of Wastewater Collection

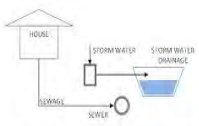
Sewer development = Treatment volume of WWTP

Outcome (2) : Improvement of Cost Performance (with PPP)

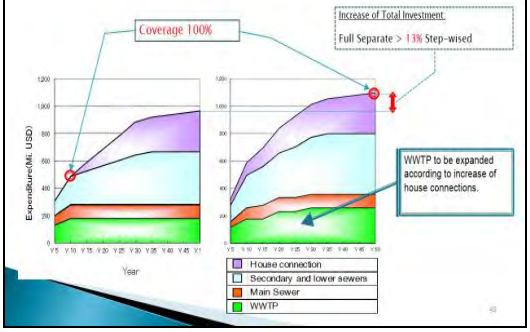
Second stage (after Year 10)

→ Development of House-connection

Outcome (3) : Completion of House-connections



Cost Comparison between Step-wised and Full Separate



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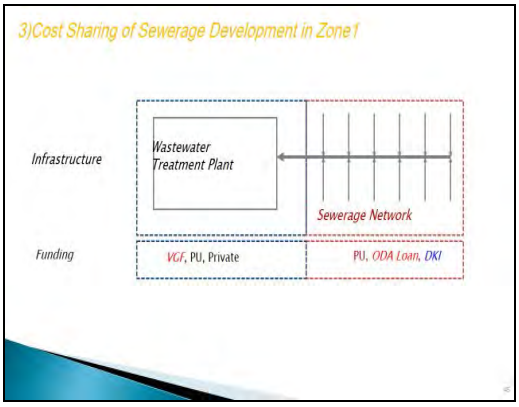

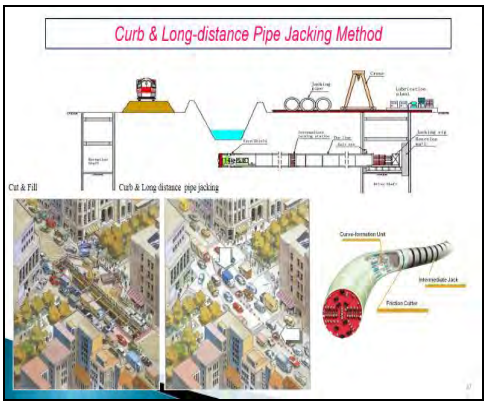

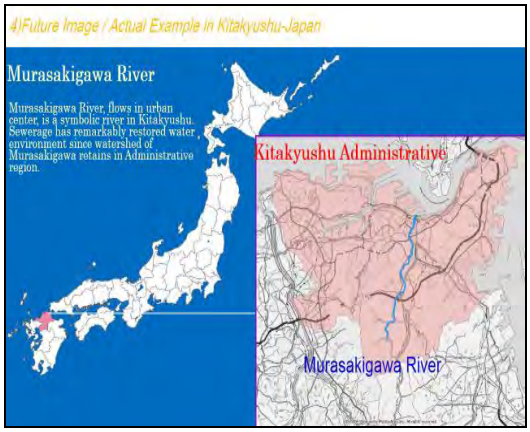

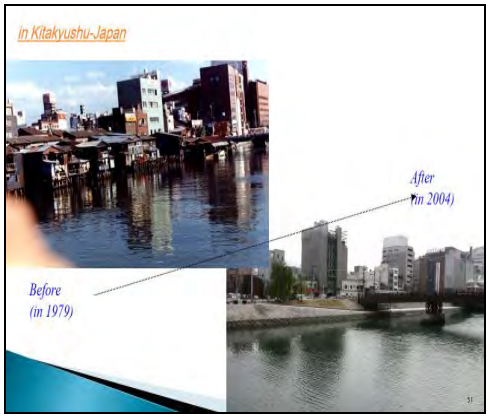

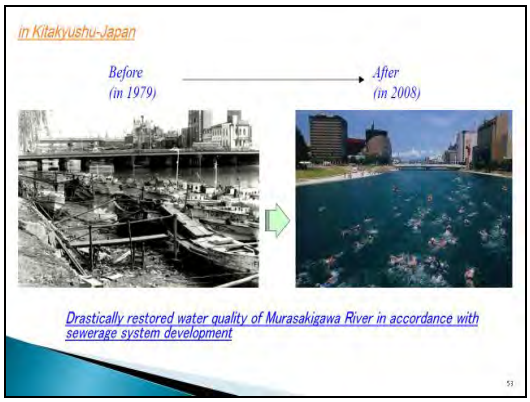

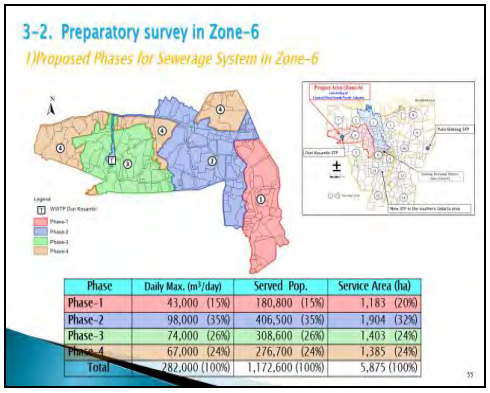

Phase	Daily Max. (m³/day)	Served Pop.	Service Area (ha)
Phase-1	43,000 (15%)	180,800 (15%)	1,183 (20%)
Phase-2	98,000 (35%)	406,500 (35%)	1,904 (32%)
Phase-3	74,000 (26%)	308,600 (26%)	1,403 (24%)
Phase-4	67,000 (24%)	276,700 (24%)	1,385 (24%)
Total	282,000 (100%)	1,172,600 (100%)	5,875 (100%)

2)Zone-6 Sewerage Investment in the New Master Plan (M/P)

Outline of Zone-6 Sewerage Investment (New M/P)

Phasing		Ultimate Phase	Phase-1
Area of Project Site	ha	5,875	1,183
Design wastewater flow	Daily average	235,000 m³/day	36,000m³/day
	Daily maximum	313,000m³/day	43,000m³/day
Facility Coverage Ratio		80	80
Design administrative population		1,465,718	226,000
Design served population		1,172,574(9.4% of DKI)	180,800(1.5%)
Sewers	Trunk sewer	24 km	16 km
	Main sewer	155 km	18 km
	Secondary & Tertiary	829 km	110 km
Relay pumping station		1 unit	0 unit
WWTP Capacity		313,000m³/day	43,000m³/day

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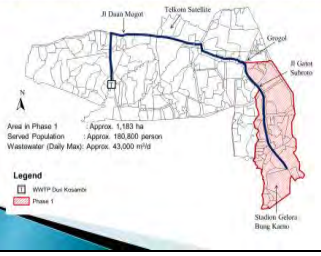
3)Design Basis

Phase	Project Area (ha)	Wastewater (m³/day) Daily Ave.	Daily Max	Design Pop.	Design Served Pop.	Remarks
Ultimate Phase	5,874	235,000	282,000	1,465,700	1,172,600	Whole Zone-6
Phase-1	1,183	36,000	43,000	226,000	180,800	Zone-6 Area 20%



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4)Cost Estimates

Items	Cost (Million IDR)	
Phase	Ultimate Phase	Phase-1
A. Construction Cost	5,940,185	2,214,595
(1)WWTP	2,140,883	735,285
(2)Sewers	3,799,303	1,479,310

	Items	Billion IDR	%
Initial cost	Construction cost	2,220	44%
	Price contingency and physical contingency	1,810	36%
	Administration, Engineering cost, Tax and others	980	20%
	Total	5,010	100%

◆ Financial Evaluation (Zone-6 only, Grant 65% Loan 35%)
Without tariff increase B/C Ratio: 0.40 FIRR: no solution
With tariff increase B/C Ratio: 1.03 FIRR: 1.57%

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4. Materialize for Sewerage system development

1)Sewerage System Development Project in DKI Jakarta(E/S) 2014-2017

-Engineering service for Sewer Network-DD, Tender Assistance

2)JICA Supplement Study for Pilot Project of Sewer Network

-Engineering service for P/P of Sewer Network-DD, Tender Assistance

3) Technical Assistance Project for

-PPP scheme development assistance for WWTP in Zone1

4)Pilot Survey for Disseminating Small and Medium Enterprises technologies for PIPE JACKING SEWERAGE WORKS

5)Implementation program

5.JICA's Assistance for Private Sector

1. Background

The Supply Side
Japan as a country with rich technological foundation

The Demand Side
Diversification and emergence of global development agendas

2. Assistance Model

Partner Countries' Development Agenda
Any development issue that a partner countries' public agency is tasked to tackle.

Benefit for both side
Areas where the specific "Development Agenda" match the specific "Japanese Technology".

Japanese Companies' Technology
Any technology that can be utilized to tackle the development agenda of the partner country.

JICA's Assistance
MATCHING OF THE PARTNER COUNTRIES'S DEVELOPMENT AGENDA
And
JAPANESE COMPANIES' TECHNOLOGIES

3. Anticipated Positive Impact

Improvement in Targeted Development Agenda

Expansion in Technical Capabilities of the Partner Country

Possibility of Rise in Employment Opportunity

参考 6

JICA's Schemes based on proposals by Private Sector

Information Collection/Study	· SME Partnership Promotion Survey · Preparatory Survey for BOP Business Promotion · Feasibility Study of realizing ODA projects making use of SME' Products and Technologies
Verification/ Promotion of Product	· Collaboration Program with Private Sector for Disseminating Japanese Technology · Pilot Survey for disseminating SMEs' Technologies
Human Exchange	· Private-sector Coordination Volunteer

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JICA's Schemes based on proposals by Private Sector

Information Collection/Study

SME Partnership Promotion Survey
- To support Japanese SMEs that seeks to conduct new business which responding to development challenges .
- Up to 10 mil JPY (Approx. US$ 100,000)

Preparatory Survey for BOP Business Promotion
- To promote private sector BOP business (inclusive business) which responding to development challenges .
- Up to 50 mil JPY (Approx. US$ 500,000)

Feasibility Study of realizing ODA projects making use of SME's Products and Technologies
- To assist Japanese SMEs to verify the effectiveness of the SME's technologies
- Up to 50 mil JPY (Approx. US$ 500,000)

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JICA's Schemes based on proposals by Private Sector

Verification/Promotion of Product

Collaboration Program with the Private Sector for Disseminating Japanese Technology
- To adapt goods, techniques and know-how as well as the system proposed by Japanese private corporations in order to support the social and economic development.
- Up to 20 mil JPY (Approx. US$ 200,000)

Pilot Survey for disseminating SMEs' Technologies
- To demonstrate and improve the effectiveness of SMEs' technologies for the social and economic development through dissemination of their products
- Up to 100 mil JPY (Approx. US$ 1,000,000)



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JICA Examples of Products and Areas of Assistance

	Area of Assistance	Examples of Technologies
1	Environment, Energy, Waste Disposal	Composting toilet, Precipitation monitoring system
2	Water Purification, Water Management	Water quality measurement equipment, bioremediation kit, water purifier
3	Occupational Training, Industrial Development	Craft equipment, inspection/measurement equipment
4	Welfare	Wheelchair, Rehabilitation equipment, nursing care equipment, printer of braille
5	Agriculture	Irrigation pump, harvesting equipment, processing equipment
6	Health and Insurance	X ray, fetal monitor, dental equipment
7	Education	Science educational tool kit, experimental kit
8	Hazard Prevention and Management	Makeshift lighting, Hazard management rescue equipment

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JICA Pilot Survey for disseminating SME's Technologies on Pipe Jacking for Sewerage Works

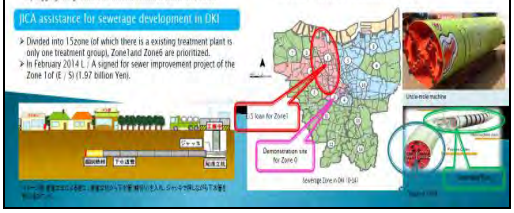
Outline
- PE and the applicability and superiority of the curve, long-distance jacking method of Iseki Poly-Tech, Inc. by technology demonstration project, understanding local construction companies and central and state government, to local residents.
- Study for the construction of a maintenance system propulsion unit.
- Human resource development through training and invited Japan DIT construction of demonstration.
- In cooperation with construction companies and equipment suppliers, etc. in Indonesia, and develop a business model.

- Proposed company : Iseki Poly-Tech Inc.
- Site: Jakarta city
- Counter Part Agency: DKI Jakarta, PD-PALJAYA
- Project period: Sept 2013-June 2014

Introducing new construction methods
- The ability to develop a sewage pipe without cutting the road, it is possible to minimize ground occupancy, to minimize the influences traffic.
- Capable of drilling in a wide range of soil conditions.
- High safety remote operation is possible from the ground control room. By digging the ground a minimum, minimize waste and noise.

Develop future business opportunity
- Establish a technology assessment of jacking method in Indonesia, and business to target sewer development in Zone 0, Zone1 and other Sewerage Zone in Jakarta and other cities.
- Established a joint venture in the field, and implementation of supply machine unit, maintenance system, and construction consulting.

JICA assistance for sewerage development in DKI
- Divided into 15zone (of which there is a existing treatment plant is only one treatment group), Zone1 and Zone6 are prioritized.
- In February 2014 L / A signed for sewer improvement project of the Zone 1of (E / S) (1.97 billion Yen).



Future Image of the Goal:

Future Image / kitatakyushu-Japan & Caoshiung-Taiwan

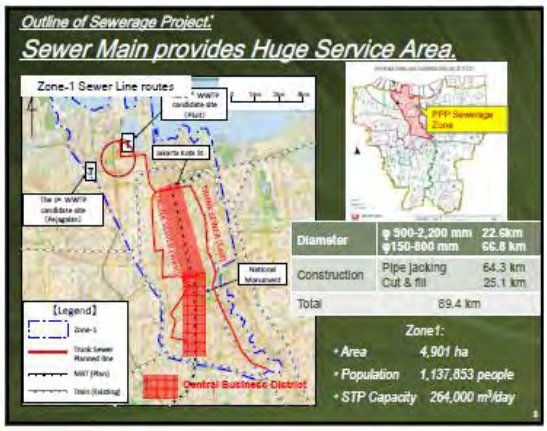
At Present




Love River Water Front　Dragon Boat　Festival

83

3. プレゼンテーション-1：井上団員（日本工営）



Microtunneling Sector in Jakarta & Japan is Now !!

- **Public & Private Collaboration of both Countries.**
  - Pilot Survey of PD PAL Jaya & Iseki Poly-Tech. Inc. in Jl. Sudirman
  - Ciliwung – Banjir Kanal Timur Bypass Project for flood control
  - Supplemental Study for Sewerage Development (in Pluit)

7

"Curve & Long Distance Pipe Jacking"

for

not only Sewerage development,

but also

all Infrastructure development

of Tele-communication & Electricity,

Water supply, Storm water management, etc..

8

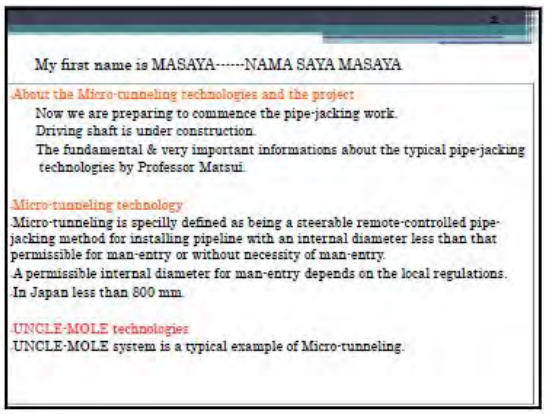
Thank you

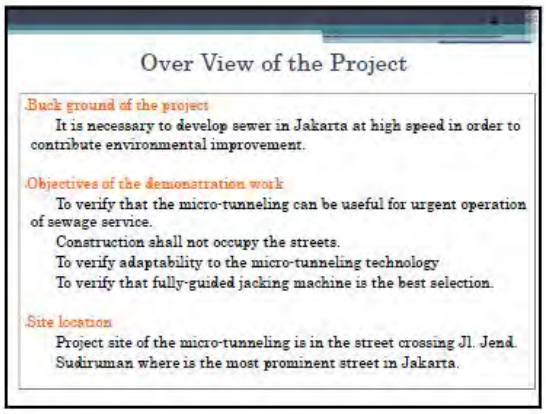
&

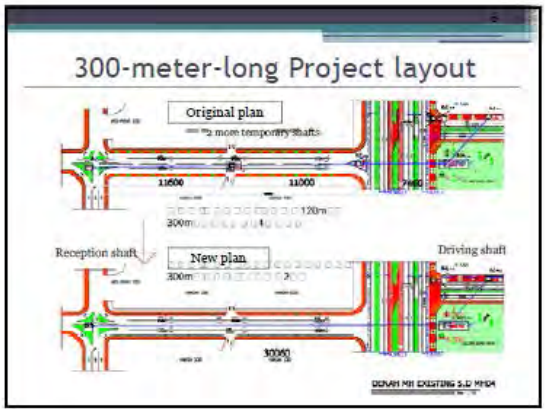
Terima Kasih

9

4. プレゼンテーション-2：平井団員・佐々木団員（イセキ開発工機）

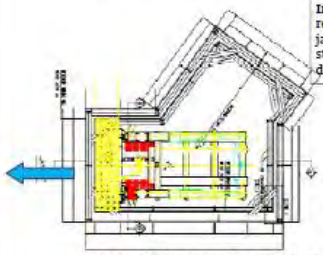






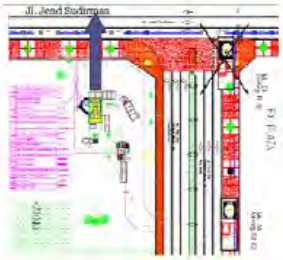
Driving shaft & reception shaft

In the driving shaft, thrust or reaction wall, main jacks on the jacking frame, tunnel entrance steel ring, survey tools, and drainage should be installed.



Driving shaft size is 7 meter × 4 meter × 8.3 meter.

Equipment layout at the construction site



Jacking frame & main jacks

The jacking system can be comprised of either a jacking frame that locks into a skid frame and is capable of handling various length of pipe or it may be comprised of a number of individual cylinders that transfer the thrust ring that mates to the pipe being jacked.

Load & capacity

Item	Load assumed
Main jacks capacity	1,500 kN×2
Resistance for 300 m jacking	2,561 kN
Pipe allowable axial load	3,770 kN

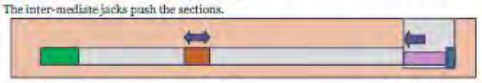
Inter-mediate jacking system

Often times the use of over-size cutting and the adequate lubricant is not enough assurance that the friction to jack the pipe through the soil will be overcome.

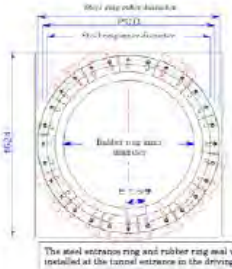
In addition to the jacking frame, intermediate jacks will be installed between the pipes.

Inter-mediate jacks capacity is 300 kN ×8

The inter-mediate jacks push the sections.



Steel entrance ring with rubber seal



The steel entrance ring and rubber ring seal which will be installed at the tunnel entrance in the driving shaft.

Entrance eye opening work at the tunnel entrance before commencement of pipe jacking.

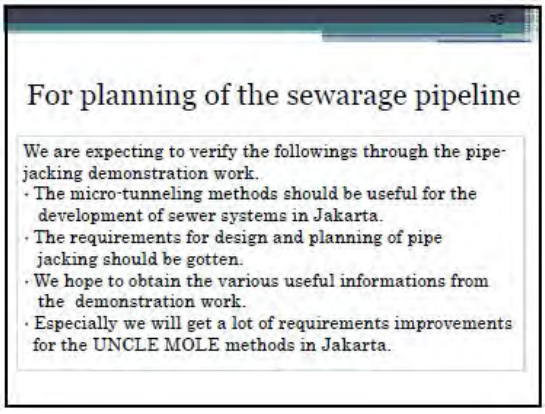
Slurry & high-quality lubricant system

Injecting a high quality lubricating slurry around the outside of the pipes must be used to reduce skin friction and increase jacking distance, even over size cut adequate.

The lubricant helps to reduce the jacking force by modifying the nature of the contact between the soil and the pipe.

SMOOTH ACE produced TACHIBANA MATERIAL CO.,LTD will be used for the lubricant.

Lubricant injecting system



5. 講評（まとめ）：公共事業省人間居住総局中島 JICA 専門家

- ジャカルタは、1,000 万人を超える大都市であるが、最も下水道の整備が遅れた都市である。
- 3 年間の極めて短期間で、MP、FS、パイロットプロジェクトの起工式を迎えるに至った。
- カーブ・長距離推進工法は、ジャカルタに適した工法であり、TMCM（Tanpa Machet：渋滞しない、 Cepat：早い、Muda：安価）である。

6. 質疑応答

(6) 松井教授

- 6 年前にジョグジャカルタ市長から推進工法を採用したいとの打診を受けて、ジャカルタでの推進工法技術の適用を検討してきた。
- インドネシアの大都市では、推進工法技術の適用が考えられる。
- **Mr. Amien**

(Q)　推進工法が、推進距離 1km、埋設深さ 40m の条件で適用されているという報告である。推進管の品質は、推進抵抗、水圧にどのように耐えるのか。

(A)　推進距離は、周辺摩擦力を軽減することが重要である。滑剤の適用がノウハウである。水圧については、インドネシア企業と 30m の水圧（試験では 40m を確認する）に耐える推進管・継ぎ手を開発中である。

(Q)　MH 築造・サービス管はどのように接合するのか。

(A)　主要道路に埋設される準幹線の接合と目視による管渠点検の維持管理性を考慮した MH を設けることが、施設計画の業務である。立坑の位置は、幹線道路の交差点毎に、300～500m 程度の間隔で慎重に決めなければならない。立坑位置を確保できない場合には、大口径ボーリングによる点検口を設ける場合も想定される。

- Nindja Karya

(Q) シールド工法と推進工法とでは、ジャカルタ下水にはどちらが適用できるのか。

(A) コスト面では、1,000m 以上ではシールド工法、それ以下では推進工法が有利である。併用型（コンビネーションタイプ）も開発されており、300m 程度を推進工法、それ以後をシールド工法にコンバートする。

(Q) コストは、どの程度か。

(A) 土質条件、推進距離、関係を教えてもらいたい。個別に情報提供する。

- PD PAL Jaya

(Q) 管径 5m の大口径の推進管では、近隣の埋設施設に対する影響をどのように配慮するのか。Safe distance は、どの程度か。

(A) 掘削土量を管理する。影響範囲は、1.5D として管理する。1.5D 以下でも施工管理可能である。

(Q) 泥水式と土圧式で、地表面に沈下への影響は、どのように違うのか。

(A) 両工法とも、同等と見ている。

- 公共事業省中島 JICA 専門家

(Q) カーブはどういうメカニズムで制御するのか。地中接合は可能か。

(A) 左右のジャッキを制御することによりカーブ推進する。位置の測量、RSG を装備する、推進力伝達材を組み合せて、カーブ推進を可能とする。

7. 閉会挨拶：脇田団員（イセキ開発工機）

参考資料２　2015.9.1 現地セミナー（第２回）

日　時：　2015 年 9 月 1 日（火）9:30～15:40
場　所：　バンドン工科大学（Institute Technology of Bandung）
出席者：　バンドン工科大学の生徒　100 名　（卒業生含む）
政府関係者（石炭鉱物）15 名
高速道路関連企業 2 名
鉱物関連企業 2 名
計 119 名程度

【セミナープログラム・概要】

プログラム名	登壇者	発表内容
1）開催の言葉	Sri Widiantoro 教授 （ITB）	
2）開催宣言	佐々木　勝之 （イセキ開発工機）	
3）プレゼンテーション-1	推進説明動画	イセキ開発工機製 （インドネシア語字幕付）
4）プレゼンテーション-2	松井 紀久男 （九州大学名誉教授）	推進工事基礎知識
5）プレゼンテーション-3	島田　英樹 （九州大学教授）	推進工事における滑材と推力について
6）プレゼンテーション-4	佐々木 勝之・Alvan （イセキ開発工機）	スナヤン地区実証工事報告
7）プレゼンテーション-5	平井　正哉 （イセキ開発工機）	非開削技術の応用
7）閉会挨拶	松井　紀久男 （九州大学名誉教授）	

【セミナー内容】

佐々木・アルファン

Case Study of Micro-tunneling
【UNCLEMOLE】

One Day Seminar of Micro-tunneling

Venue Institute technology of Bandung

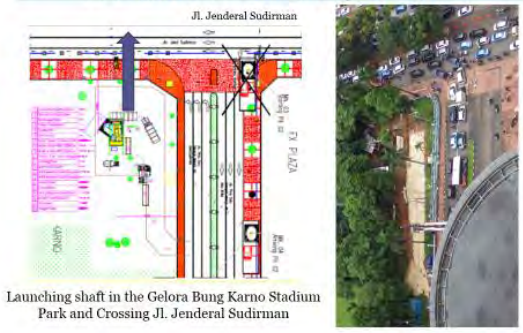
SEP 1 2015.

ISEKI Poly-tech Inc. Tokyo Japan

PROJECT OUTLINE

- JICA：Japan International Corporation Agency
- Aims of Project：Introduction and Localization of Pipe Jacking (Micro-tunneling) Technologies for Storm Drainage and Sewage Works
- Proposed Product and technology：UNCLEMOLE micro-tunneling (machine)
- Machine Producer：ISEKI POLY-TECH Inc.
- Project Procurer：PD PAL Jaya
- Location of Project：in Gelora Bung Karno Stadium Park and Jl. Jed. Sudirman

Location of Construction Site



Launching shaft in the Gelora Bung Karno Stadium Park and Crossing Jl. Jenderal Sudirman

UNCLEMOLE Micro-tunneling machine

UNCLEMOLE-L is the best suited to this project conditions based on our previous experience with the similar machines.

In-built crusher with an eccentric radial motion ensures that no ground particle larger than the slurry system can handle enters the return side of the system.

UNCLEMOLE series produced by ISEKI POLY-TECH Inc. belong to the category of closed, full face excavation machines with a hydraulic slurry circuit.

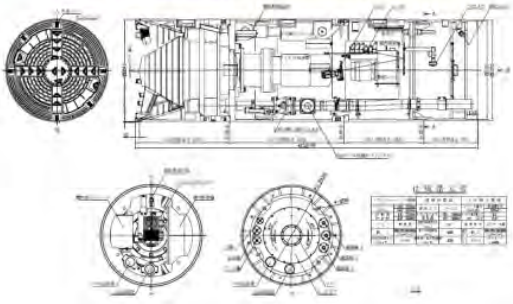
Dimensions & Specification of Machine

Item	Descriptions
Allover Length	4,153 mm
Outer diameter	1,240 mm (over cutting bit)
Direction Control Jacks	723kN ×3
Crusher head (torque)	149 kN-m

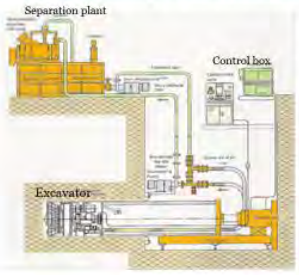
UNCLEMOLE – L 1000

In-built crusher

RSG Laser guidance system



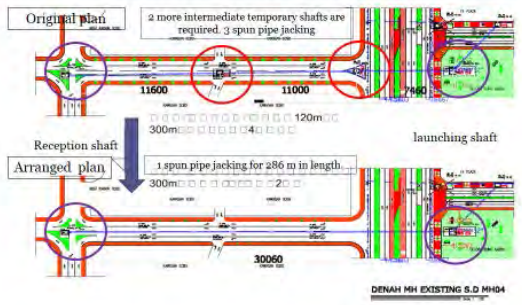
Excavation system of the Slurry pressure balance type micro-tunneling



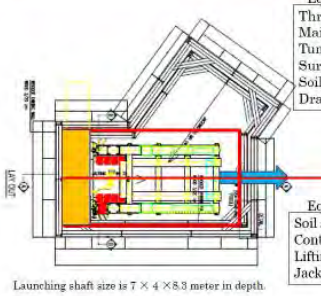
Micro-tunneling is an excavating technology used to construct small tunnel. These small diameter tunnels make it impossible to have an operator in the machine itself. The micro-tunneling excavating machine must be operated remotely.

The excavated materials are transported to the ground surface through the slurry discharging pipe.

286-meter-long Project Plan



Driving Shaft



Equipment in the Driving shaft
Thrust wall
Main jacks on the jacking frame
Tunnel entrance steel ring
Survey instruments
Soil discharging & slurry pipes
Drainage (pipes and pumps)

Equipment on the Ground
Soil separation plants
Control cabin
Lifting machines(excavator, pipes)
Jacked pipe stock yard

Launching shaft size is 7 × 4 ×8.3 meter in depth.

Jacking frame & main jacks

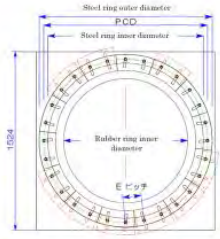
The jacking system can be comprised of a jacking frame, thrust ring and main jacks.
The jacking frame is capable of handling various length of pipe.
The jacking frame is comprised of a number of individual cylinders that transfer the thrust ring that mates to the pipe being jacked.

Load & capacity

Item	Load assumed
Main jacks capacity	1,500 kN×2
Resistance for 290 m jacking	2,561 kN
Pipe allowable axial load	3,770 kN

Intermediate jack system are provided for the unexpected load increase.

Steel entrance ring with rubber seal

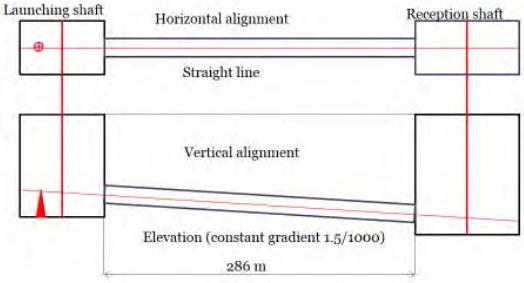


Steel entrance ring with circular rubber seal will be installed at the tunnel entrance in the launching shaft.

Entrance eye opening work at the tunnel entrance before commencement of pipe jacking

Original Designed Tunnel Alignment

Surveying is required in the planning and execution of the micro-tunneling



Arranged Tunnel Gradient

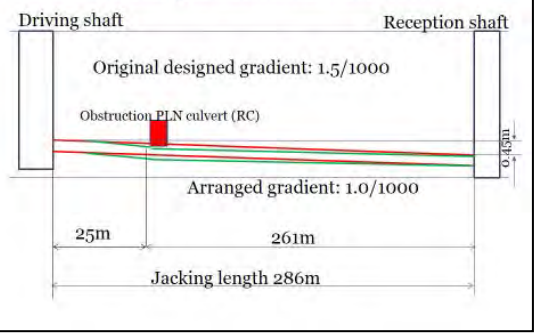
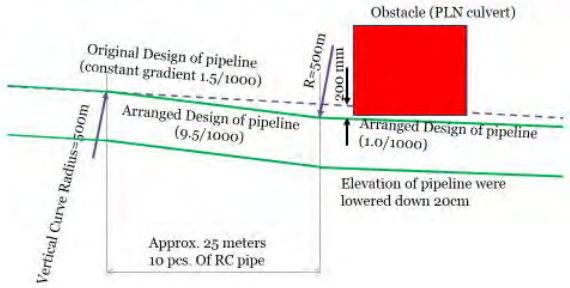
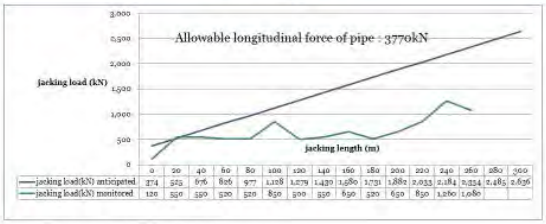


Illustration of arranged elevation of pipeline



Jacking load



jacking length (m)	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300
jacking load(kN) anticipated	374	525	676	826	977	1,128	1,279	1,429	1,580	1,731	1,882	2,033	2,184	2,334	2,485	2,636
jacking load(kN) monitored	120	550	590	520	520	850	900	930	890	920	650	830	1,280	1,080		

Anticipated jacking load $F = F_0 + f_s \times L$
Cutting face pressure $F_0 = (Pw + Pe) \times \pi \times (Bs/2)^2$
Frictional force around pipe $f_s = \tau a \times S$

Anticipated jacking load is a maximum expected jacking load.
Cutting face pressure is expected as 300 kN/m2
Frictional force around pipe is expected as 2.0kN/m2.

To reduce the frictional forth by over-cut & using adequate lubricant

- As the tunnel length increases, the friction of the ground around the pipes might increase.
- 2 practical methods are used to minimize the friction.
- Over size cutting was used to make a slight gap between the inner edge of the tunnel and the outer edge of the pipe.
- An economical and ecologically friendly lubricant was injected into this gap.

Inter-mediate jacking system

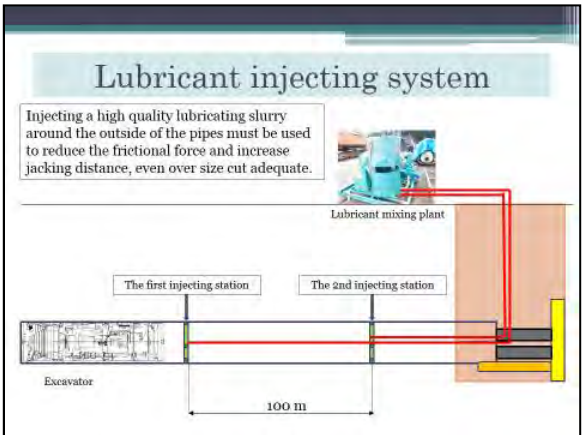
Often times the use of over-size cutting and the adequate lubricant is not enough assurance that the friction to jack the pipe through the soil will be overcome.

In addition to the jacking frame, intermediate jacks was installed.

Inter-mediate jacks capacity is 300 kN × 6

Lubricant injecting system

Injecting a high quality lubricating slurry around the outside of the pipes must be used to reduce the frictional force and increase jacking distance, even over size cut adequate.



Design of a thrust wall

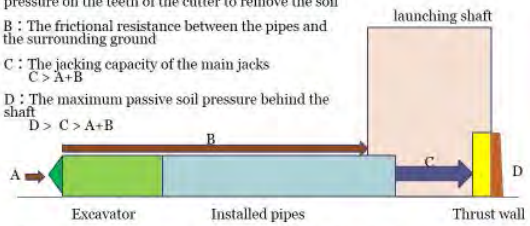
Reaction force =A+B

A : The horizontal force to provide the necessary pressure on the teeth of the cutter to remove the soil

B : The frictional resistance between the pipes and the surrounding ground

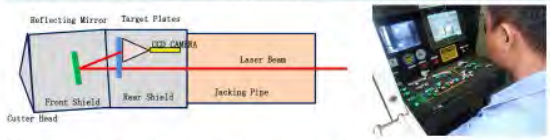
C : The jacking capacity of the main jacks
C > A+B

D : The maximum passive soil pressure behind the shaft
D > C > A+B



- A thrust wall is constructed to provide a reaction against the jacking force.
- Sufficient reactions against the jacking force should be provided.

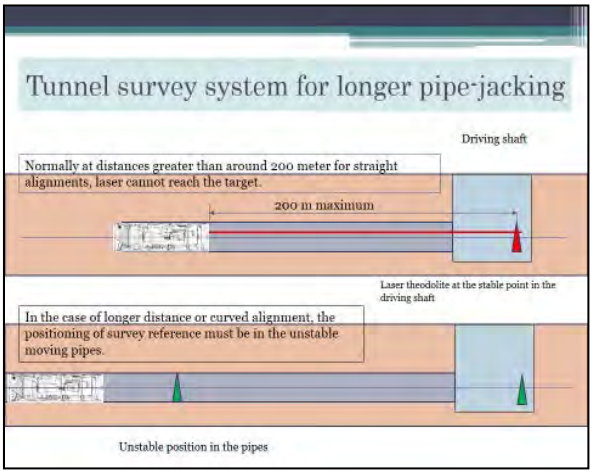
Laser Guidance system & Machine Control



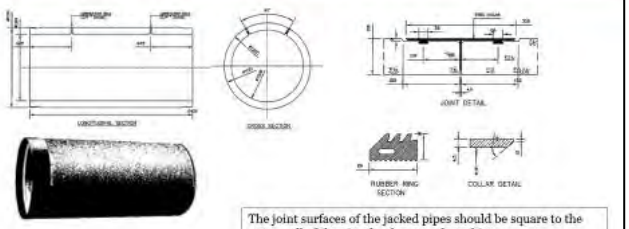
The operator can get the information about the machine position & direction from the RSG system.

RSG laser guidance system

Tunnel survey system for longer pipe-jacking



Jacking pipes were produced in Jakarta



The joint surfaces of the jacked pipes should be square to the outer wall of the pipe for the smooth pushing.

Jacking pipe dimensions

Nominal diameter	Pipe outside diameter	Pipe wall thickness	Pipe length	Steel coupling thickness	Steel coupling width
D (mm)	Do (mm)	T (mm)	L (mm)	Tc (mm)	Lc (mm)
1000	1200	100	2430	4.5	250

Conclusion

- About the Micro-tunneling project
  The JICA micro-tunneling project has been completed.
  Very important knowledge have gained by the project.
  The fundamental & very important information about the micro-tunneling technologies were provided by Professor Matsui.
- Micro-tunneling technology
  Micro-tunneling is specially defined as being a steerable remote-controlled pipe-jacking method for installing pipeline.
  A properly planned and well executed subsurface investigation prior to construction should provide a firm basis for micro-tunneling construction.
  It will reduce the risk of encountering differing site conditions.
  Subsurface information is of utmost importance for contractors working on micro-tunneling so that the future projects proceed as planned.
  Laser targeting system and remote-controlled machine steering system are essential for the accurate micro-tunneling.
  The maximum amount of monitored pipe jacking load dose not exceed the anticipated jacking load.
- UNCLE-MOLE technologies
  UNCLE-MOLE is the most appropriate method for Micro-tunneling project in Jakarta.

Thank You Very Much for your Corporation

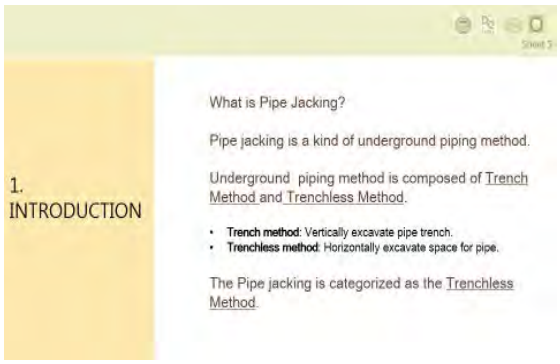
参考資料 3　2015.10.15 現地セミナー（第 3 回）

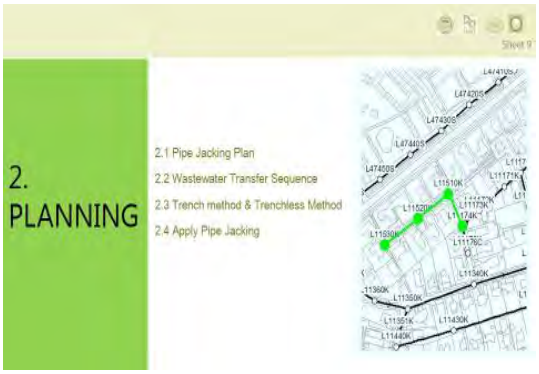
日　時：　2015 年 10 月 15 日（木）13:00～15:40
場　所：　Cipta Karya（公共事業省）
出席者：　各地方の公共事業省　20 名　（卒業生含む）
　　建設会社 10 名
　　計 35 名程度
主催 ：DACAREA, CRM, ISEKI POLY-TECH, Inc, PT Bona Indonesia(推進管メーカー)

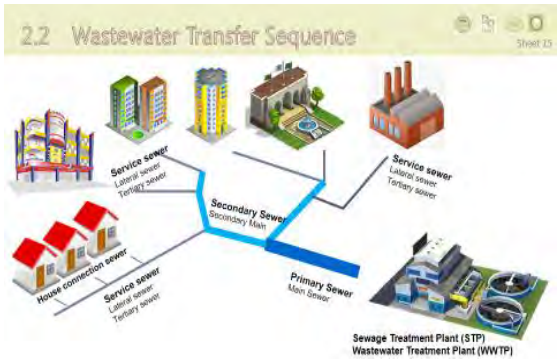
【セミナープログラム・概要】

プログラム名	登壇者	発表内容
1）開催の言葉	Mr Albert Reinaldo, ST (Ministry of Public Works & Hosing)	
2）プレゼンテーション-1	Mr Koichi Suzuki (DACREA)	推進工法の優位性・計画時に注意点など
3）プレゼンテーション-2	Mr Katsuyuki Sasaki （イセキ開発工機）	スナヤン地区実証工事報告及び推進工法の詳細について
4）プレゼンテーション-3	Mr Guillaume Beduneau （PT Bonna Indonesia）	推進管について
5）質疑応答	Mr Albert Reinaldo, ST	

【プレゼン内容】

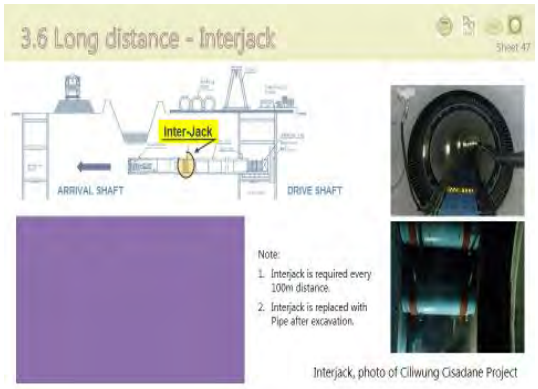

1.
INTRODUCTION
What is Pipe Jacking?
Pipe jacking is a kind of underground piping method.
Underground piping method is composed of Trench Method and Trenchless Method.
Trench method: Vertically excavate pipe trench.
Trenchless method: Horizontally excavate space for pipe.
The Pipe jacking is categorized as the Trenchless Method.

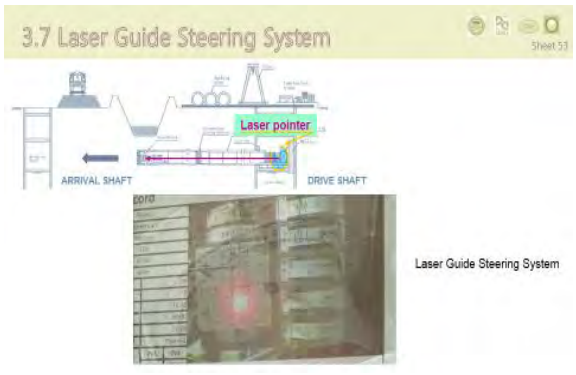

2.
PLANNING
2.1 Pipe Jacking Plan
2.2 Wastewater Transfer Sequence
2.3 Trench method & Trenchless Method
2.4 Apply Pipe Jacking


2.2 Wastewater Transfer Sequence
Service sewer
Lateral sewer
Tertiary sewer
Secondary Sewer
Secondary Main
House connection sewer
Primary Sewer
Main Sewer
Sewage Treatment Plant (STP)
Wastewater Treatment Plant (WWTP)

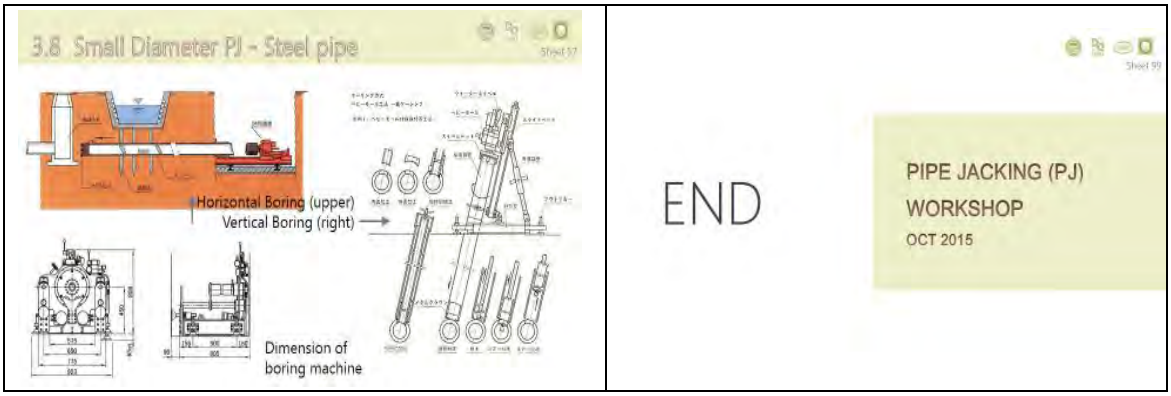

2.4 Apply Pipe Jacking
Piping and Wiring under the Roads
Piping and Wiring under the Rivers
Railway Crossing
AREA APPLIED PIPE JACKING


3.5 Shaft and Jacks
ARRIVAL SHAFT
DRIVE SHAFT
Type of Shaft Retaining Work
SHEET PILE
LINER PLATE
STEEL CASING


3.6 Long distance - Interjack
Inter-Jack
ARRIVAL SHAFT
DRIVE SHAFT
Note:
1. Interjack is required every 100m distance.
2. Interjack is replaced with Pipe after excavation.
Interjack, photo of Ciliwung Cisadane Project


3.7 Laser Guide Steering System
Laser pointer
ARRIVAL SHAFT
DRIVE SHAFT
Laser Guide Steering System


3.8 Small Diameter PJ- PVC pipe
Small diameter vertical pipe jack
Small diameter horizontal pipe jack
Combination of PVC casing pipe (outer) and Sewer (inner)



質疑応答

Q1：土質や地下水等で掘進機を選ぶということだが、砂、粘土、礫、岩盤全て教えて欲しい。また、それぞれの工事費についても教えて欲しい。

A1：全ての回答をここで行うのは難しい。砂や粘土、、あまり大きくない礫ならばアンクルモールを、多い礫や岩盤はアンクルモールスーパーで対応できる。岩盤強度等によってはビットの種類や配列を変更することが有効となることがあるので個別に問い合わせて欲しい。工事費については、口頭だけの説明では回答が困難なので、後日具体的な計画あるいは条件を明示してもらえれば、資料を送る。

Q2:推進工事を行うときに、複数の発進側から同時に施工を行い、到達させることは可能か
A2:同じ日に到達させることは難しいが、それをずらせば施工可能です。

Q3;各家庭から下水道本管に接続する推進工法はあるのか？
A3:取付管推進工法というのものがある。

Q4：立坑の大きさや管の耐圧力には規格があるのか？
A5: 立坑には、埋設する管径や立坑種類によって一定の基準があります。管の耐圧力にも一定の基準がありますが、条件を変えることもできます。

参考資料 4　2015.11.26 現地セミナー（第 4 回）

日　時：　2015 年 11 月 26 日（木）9:20～13:00
場　所：　Morrissey Hotel
出席者：　インドネシア国政府関連者　40 名
コンサルタント　2 名
バンドン工科大学　1 名
イセキ関連者　　5 名
計 50 名程度

【セミナープログラム・概要】

プログラム名	登壇者	発表内容
1）開催の言葉	Mr Adi （DKI）	
2）開催の言葉	Mr Saito （Jica Indonesia）	
3）開催の言葉	Mr Junier Panjaitan （PD PAL JAYA）	
4）　プレゼンテーション１	Mr Tomihara （Jica Indonesia）	JICA のインドネシアにおける下水分野での活動について
5）プレゼンテーション２	Mr Sasaki & Mr Alvan （ Iseki Poly-Tech, Inc.）	ＪＩＣＡデモ施工報告
6）プレゼンテーション３	Mr Junifer Panajitan （PD PAL JAYA）	PD PAL JAYA の活動について
7）挨拶	Mr Nishi （PU）	
8）プレゼンテーション４	Mr Matsui （Iseki Poly-Tech,Inc.）	推進工法について
9）閉会の挨拶	Mr Wakita （Iseki Poly-Tech,Inc.）	

セミナーの様子

	
ＭＣと通訳	DKI（ジャカルタ）Mr Adi 氏
	
JICA インドネシア　斉藤次長ご挨拶	PD PAL JAYA Mr Junifer 社長代行挨拶
	
JICA インドネシア　富原氏プレゼン	イセキジャカルタ　佐々木所長プレゼン
	
PD PAL JAYA　Mr Junifer プレゼン	公共事業省　西専門家ご挨拶

	
松井教授　プレゼン	記念撮影

【質疑応答】

Q1. 20 年前、Zone0（中央ジャカルタエリア）で管路網建設を行ったが、そのときも推進工法を活用したのか？
回答：推進工法を使った（Mr Junifer PD PAL JAYA）

Q2. ボックスカルバートや既存の設備に衝突するのを避けるために、事前に関係機関（PLN など）と打ち合わせを蜜にするべき。また、事前打ち合わせが難しいようなら、地上から障害物を探すようなスキャナーはどうか？
回答：助言有難うございました。スキャナーは購入を検討します（Mr Junifer PD PAL JAYA）

【セミナー内容】

富原企画調査員（JICA インドネシア事務所）

1.Back Ground Condition of Sewerage Development

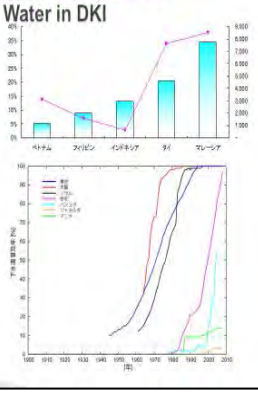
1-1. Present Condition of Waste Water in DKI

1)Condition of the sector

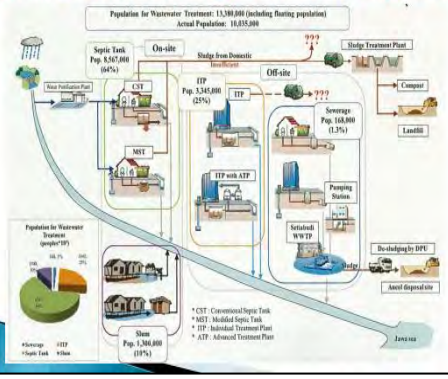
- High ratio of no access sanitary toilette 26% ,Lower proper waste water treatment ratio 2%
- Overcrowded population without proper waste water treatment cause serious hygiene condition and health damage in urban area.

2)Assistance Policy

- Sewerage development in Jakarta metropolitan area has large impact for population, health, business environment and disaster management issue.

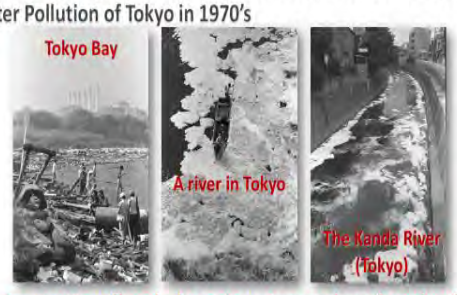


3)Present Condition of Sewerage treatment in DKI Jakarta



1-2.Sewerage system development experience in Japan

Water Pollution of Tokyo in 1970's



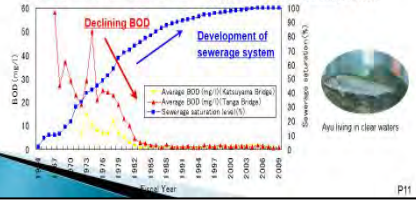
Preventing floods by rainwater and outbreak of infectious disease caused by insanitary water

Photo Credit : Environmental Bureau of the Tokyo Metropolitan Government

Improvements in Water Quality (in Kitakyusyu City)

♦ Dramatic environmental rebirth with more than 40 years of improvements of the sewerage system in Kitakyushu City

From sewage canal to clean, swimmable river — People can swim today in Murasakigawa River



P11

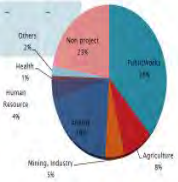
2.JICA assistance strategy

2-1. Japan/JICA assistance strategy

For further economic growth	MPA infrastructure	Transportation development
		Urban environment of MPA
	Private Sector development	Business Environment
		Electric / Energy development
		Higher Education
For equality and safe society	For equality, in connectivity	Strengthen connectivity
		Regional development
	Disaster Prevention, Emergency	CD for disaster prevention
For global issue and international society	Climate change	Climate change
	International, regional issue	International, regional issue

2-2.JICA's Performance in Indonesia(JFY 2008-2014)

Type of Cooperation	2008	2009	2010	2011	2012	2013	2014
ODA Loans (in mill US$)	1230	1162	448	754	155	354	623
Grant Aid (in mill US$)	38	28	53	11	61	27	-
Technical Cooperation (in mill US$)	74	88	115	94	62	-	-



2-3. Priority of Sewerage System Development in DKI Jakarta

From JAPAN -Indonesia Strategic Partnership

1)Japan/JICA assistance strategy

2) Metropolitan priority area ⇒ PROMOSI
(Japan -Indonesia Investment Export Promote Initiative 2015)

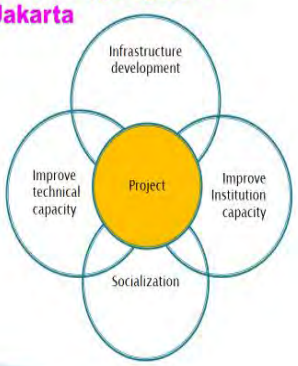
3) Japan -Indonesia Flagship project

4)MP3EI(Indonesia`s Long Run Development Plan for Six National Economic Corridors)

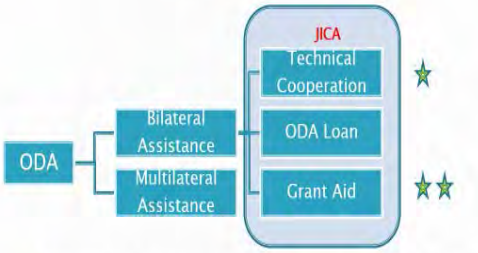
5)Listed on Indonesia Bluebook in 2015 Project "Development Sewerage System in DKI Jakarta(Zone 1 and 6)"

3.JICA Assistance for Sewerage System Development in DKI Jakarta

Integration Approach,
Scheme synergy for
effective and efficient
Development



Japan/JICA ODA



☆ Development study, T.C project, Expert dispatch, Equipment supply, Japanese Training

☆☆ Grant aids will come to be terminated since economic development situation in Indonesia. Assistance to be transition of country partnership.

3-1.Infrastructure Development

1)Sewerage system improvement Master Plan
2)Feasibility study for Priority Area (Zone1 and Zone6)
3)Detail Designing for Pilot Project in Zone1
4)Engineering Service loan for WWTP-BD, Tender Assistance Sewer Network-DD, Tender Assistance
5)Construction Loan for Zone1 and Zone 6

3-2.Institution capacity Improvement/Socialization

6)Technical Cooperation Project for Sewerage system planning capacity in DKI

3-3.Improve technical/Engineering capacity

7)Pilot Survey for Disseminating Small and Medium Enterprises technologies for PIPE JACKING SEWERAGE WORKS

3-1.Infrastructure Development

1)Master Plan Study

	Area	Average m3/day	Maximum M3/day
Short Term	1	198,000	264,000
	6	235,000	313,000
Mid term	4,5,8,10	47000-248000	62000-331000
Long term	others	24000-253000	32000-337000
Total		1977000	2636000

	Area (ha)	2,3rd Sewer(m)	Sewer Main(m)	Pump
Short	10,775	1485951	240878	1
Mid	15,301	2043273	470962	3
Long	37,328	4741416	1203205	9
Total	63,404	8270641	1915044	13

Figure S3-2 Layout Plan for Main Sewerage Facilities in Each Sewerage Zone

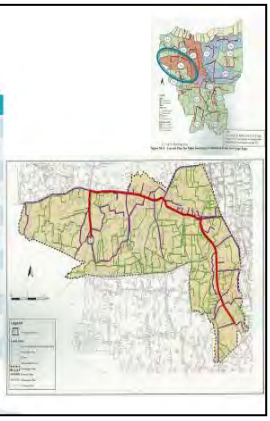
2)Priority Area

Zone I

Item	unit	No1
Area	ha	4,901
Planned Population	PE	1,236,736
Spared ratio	%	80
Spread Population	PE	989,389
Average volume	M3/day	198,000
Maximum volume	M3/day	264,000
2nd 3rd pipe(200-300mm)	km	657
Main sewer(350-800mm)	km	86
Trunk sewer(900-2200mm)	km	15.5
Pomp station		
WWTP	M3/day	264,000

Zone6

Item	unit	No6
Area	ha	5,874
Planned Population	PE	1,465,718
Spared ratio	%	80
Spread Population	PE	1,172,574
Average volume	M3/day	235,000
Maximum volume	M3/day	313,000
2nd 3rd pipe(200-300mm)	km	829
Main sewer(350-800mm)	km	155
Trunk sewer(900-2200mm)	km	24
Pomp station	M3/min	1(172)
WWTP	M3/day	313,000

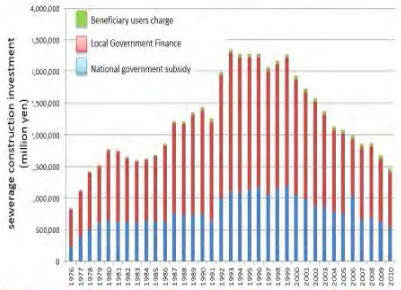


Project cost estimation

million IDR

Items	Initial cost	Replacement cost (2013-50)	Total
Short term	12656397	2606758	15176390
Zone1	5324219	1147840	6472059
Sewerage	5192315	1079250	6271565
On site	131904	68590	200494
Zone6	7265688	1438644	8704331
Sewerage	7110408	1357898	8468307
On site	155279	80745	236025
Sludge treatment plant	66490	20275	62375
Mid term (4,5,8,10)	17040187	2822798	19862985
Long term (others)	34357286	144858	34502144
Grand total	64053869	5574415	69628284

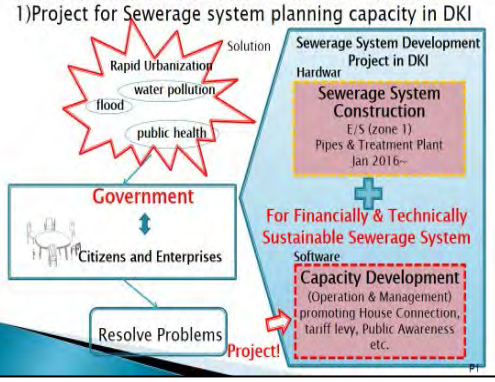
Transition of sewerage construction investment in Japan



Sewerage System has developed as Public Infrastructure For Improve Public Health, Prevention Flood, Pollution

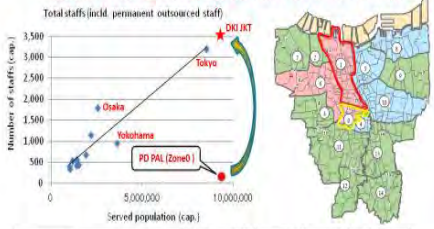
3-2,Institution capacity Improvement/Socialization

1)Project for Sewerage system planning capacity in DKI



How many staff do we need for sewerage works in DKI Jakarta?

◆ Required Number of Staff for DKI Jakarta (Estimate)
= 500 staff for Zone-1, 4,000 staff for whole DKI JKT



City		In-house staff	Outsourced staff	Total staff	Population persons
Tokyo		2,805	414	3,219	8,519,059
Jakarta	Zone 0	110	0	110	194,589
	Zone 1		500		1,137,853*
	All Zone		4,000		11,284,161*

*:Estimated Population in 2020, JICA M/P 2012 P3

Purpose and Output of Project

Overall Goal	· Administrative capacity of sewerage management is improved
Project Purpose	· Implementation structure of sewerage works in DKI Jakarta is strengthened
Outputs	1 Job allocation among relevant organizations in DKI Jakarta is clarified 2 Planning capacity of staffs for sewerage system is enhanced

P5

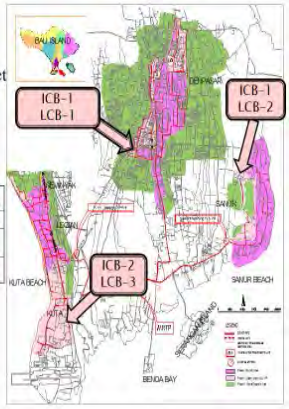
2) JICA past assistance for Sewerage Development Project

■ Denpasar Sewerage System Development Project

DSDP1 (1994-2008)5.4billion JPY
-promotion for waste water connection for commercial place
-waste issue of manhole type pumping

DSDP2
-L/A 2007 6.04billion JPY
-Loan Period: 2008-2015
-Component
ICB1: 5000m Sewer
ICB2: 4868mSewer, WWTP5100㎥
LCB: H.C 8400, tertiary sewer 3100m
E.S for operation, GIS-DB, training, PR
-Technical dissemination of Pipe Jacking

	DSDP (I)	DSDP (II)	DSDP Emergency
Area(ha)	1,145	805	2,179
Area Population	103,300	50,600	329,600
House Connection	8,674	7,200	31,050



Effect and Sustainable Development

- Large amount of grey water
- Offensive odor

- Decreasing grey water
- Diminishing odor

H.C Service Population : Planned(56%)⇒Willingness (86%)
Socialization, House Connection Incentive, Visible Improvement

■ JICA-Community sewerage treatment Project

Participatory Community Waste Water Treatment in Densely Populated Area of Yogyakarta Special Province(2001- present)

Purpose: Develop and disseminate low cost and low energy waster treatment system with community participatory approach.

Rotating Biological Contactors (RBC)

-Development model
-Community management system
-Technology development
Information and dissemination

Lending system for H.C

Community collection and payment

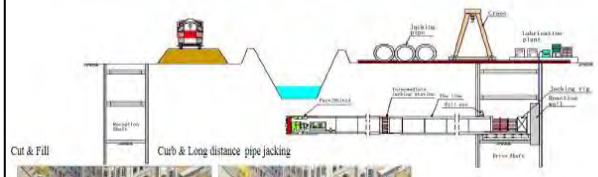
4.Improve technical /Engineering capacity cooperate with Private Sector

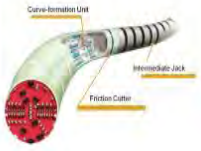
■ Back Ground of Introducing Engineering Technology from Private Sector

- In order to solve various issues, Japanese Sewerage System have established Strong Partnership between Public and Private Sector.
- We expect Japanese companies will contribute to solution of the water and environmental problems in Indonesia.
- We would like to share our management know-how with government sectors in the world for realizing sustainable sewerage systems in Indonesia.

Policy Cooperation from the Japanese Public Sector + Project and Technology from Japanese Private Companies

Curb & Long-distance Pipe Jacking Method





JICA Pilot Survey for disseminating SME's Technologies on Pipe Jacking for Sewerage Works

Outline

- PR and the applicability and superiority of the curve, long-distance jacking method of Iseki Poly-Tech, Inc. by technology demonstration project, understanding local construction companies and central and state government, to local residents.
- Study for the construction of a maintenance system propulsion unit.
- Human resource development through training and invited Japan OJT construction of demonstration.
- In cooperation with construction companies and equipment suppliers, etc. in Indonesia, and develop a business model.

- Proposed company : Iseki Poly-Tech Inc.
- Site: Jakarta city
- Counter Part Agency: DKI Jakarta, PD-PALJAYA

Introducing new construction methods

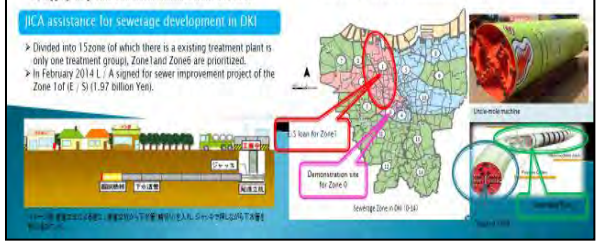
- The ability to develop a sewage pipe without cutting the road, it is possible to minimize ground occupancy, to minimize the influences traffic.
- Capable of drilling in a wide range of soil conditions.
- High safety remote operation is possible from the ground control room. By digging the ground a minimum, minimize waste and noise.

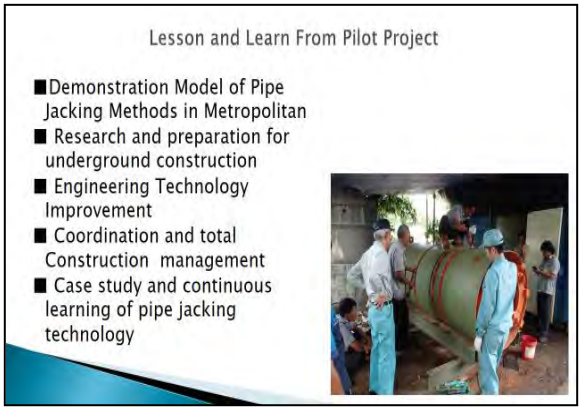
Develop future business opportunity

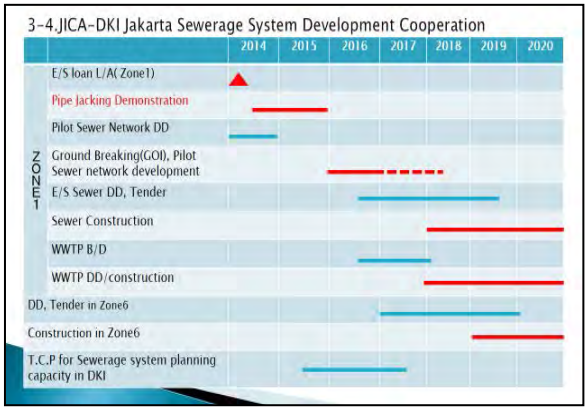
- Establish a technology assessment of jacking method in Indonesia, and business to target sewer development in Zone 0, Zone1 and other Sewerage Zone in Jakarta and other cities.
- Established a joint venture in the field, and implementation of supply machine unit, maintenance system, and construction consulting.

JICA assistance for sewerage development in DKI

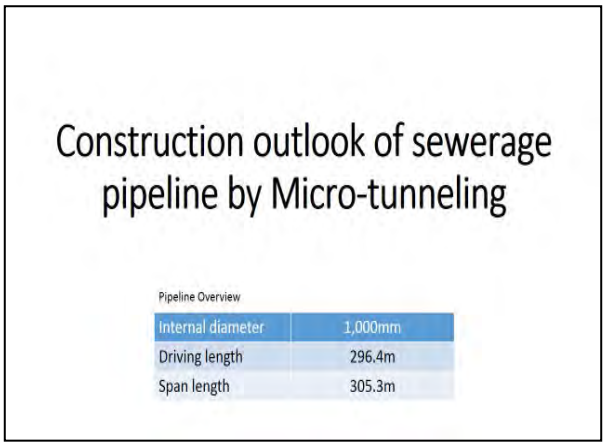
- Divided into 15zone (of which there is a existing treatment plant is only one treatment group), Zone1and Zone8 are prioritized.
- In February 2014 L / A signed for sewer improvement project of the Zone 1of (E / S) (1.97 billion Yen).





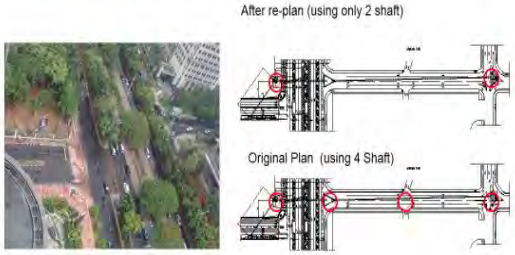


佐々木ジャカルタ所長（イセキ開発工機）

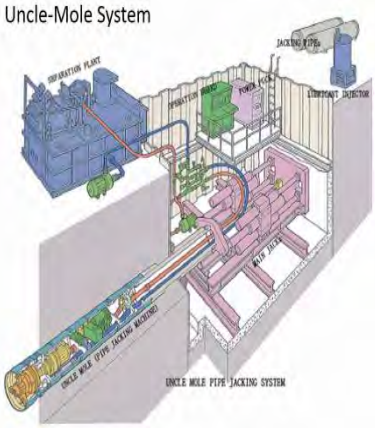


Construction Site

Bird's Eye View of the construction site



Uncle-Mole System



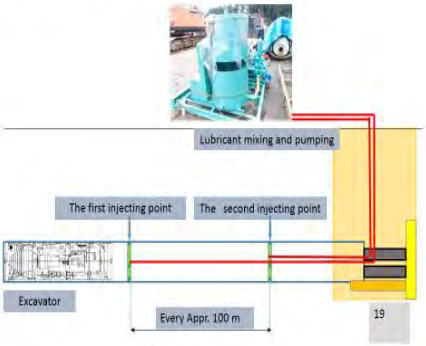
Construction shaft

Thrust Wall

Main Jacks and Jacking Frame

Intermediate Jacks

Lubricant Injecting system

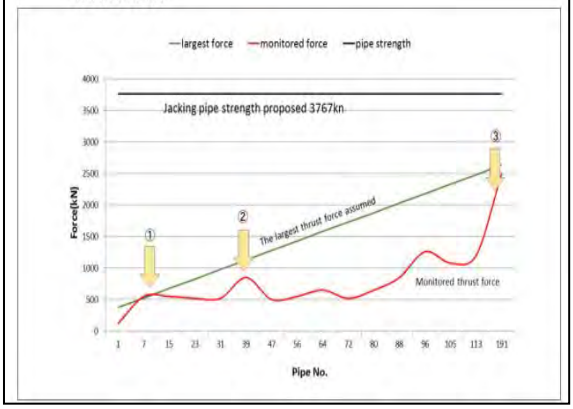


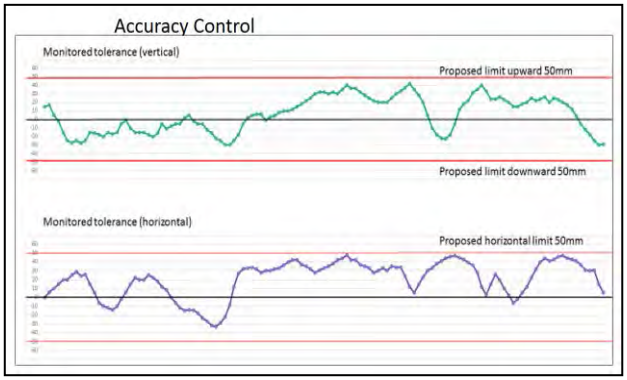
Water-tight Tunnel Entrance Ring with rubber seal

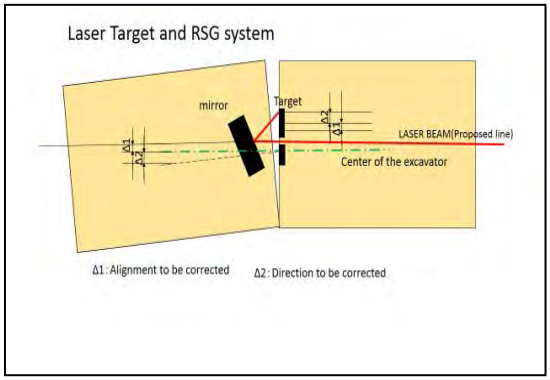
Soil Separating Plant

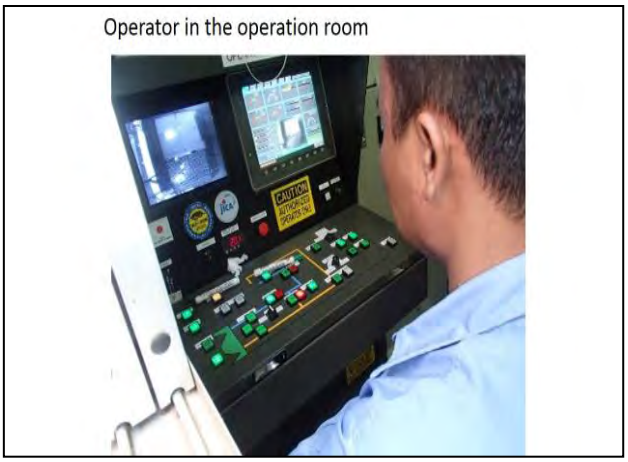
Geological Condition

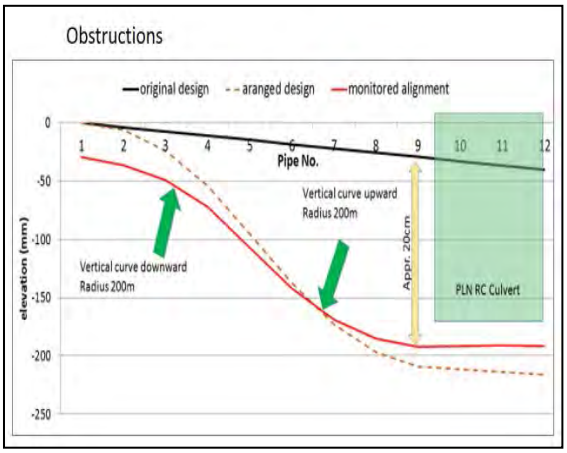
Thrust Force

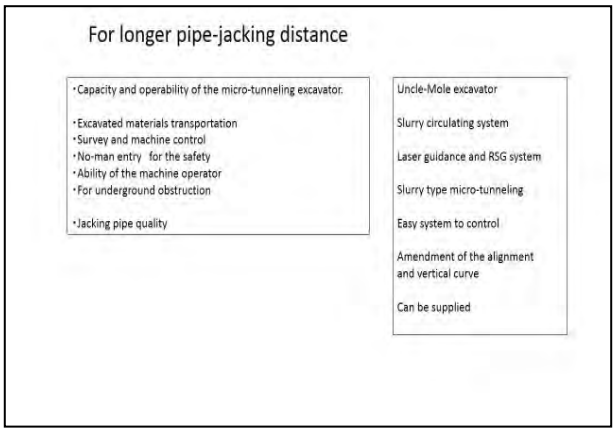



Accuracy Control
Monitored tolerance (vertical)
Proposed limit upward 50mm
Proposed limit downward 50mm
Monitored tolerance (horizontal)
Proposed horizontal limit 50mm


Laser Target and RSG system
mirror
Target
LASER BEAM(Proposed line)
Center of the excavator
Δ1 : Alignment to be corrected
Δ2 : Direction to be corrected


Operator in the operation room


Obstructions
original design
aranged design
monitored alignment
Pipe No.
elevation (mm)
Vertical curve upward
Radius 200m
Vertical curve downward
Radius 200m
Appr. 20cm
PLN RC Culvert


For longer pipe-jacking distance
・Capacity and operability of the micro-tunneling excavator.
・Excavated materials transportation
・Survey and machine control
・No-man entry for the safety
・Ability of the machine operator
・For underground obstruction
・Jacking pipe quality
Uncle-Mole excavator
Slurry circulating system
Laser guidance and RSG system
Slurry type micro-tunneling
Easy system to control
Amendment of the alignment and vertical curve
Can be supplied

松井教授（イセキ開発顧問）

Pipe-jacking/Micro-tunneling dan beberapa pembahasan teknikal

Seminar Akhir dari Pilot Project of JICA

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Shield-jacking and Pipe-jacking

Shield-jacking — Pipa dirakit dari segmen di bagian belakang mesin Shield Jacking.

Hidrolik Jack mendorong di belakang mesin Shield Jacking

Pipe-jacking

Mesin Pipe Jacking dan Pipa didorong oleh Hidrolik Jack yang disetting di Starting Shaft

Tekanan pada mata bor dari Pipe=Jacking

Untuk mendukung tekanan pada mata bor, tekanan slurry/tekanan lumpur harus dijaga. (20-50kPa). Apabila tekanannya kurang akan mengakibatkan perubahan muka tanah dan apabila kelebihan tekanan akan mengakibatkan tanah menjadi naik atau kadang menyemburnya tanah/slurry/lumpur.

- PIPE JACKING
  - OPEN FACE PIPE JACKING
    - PERSONNEL EXCAVATING — Gali Manual Diameter Dalam harus >0.8 meter
    - MECHANICAL EXCAVATING — Diameter Kecil 0.2 meter ~ 1.0 meter
  - CLOSED FACE PIPE JACKING
    - SLURRY PRESSURE BALANCE TYPE
    - MUD SLIME TYPE
    - EARTH PRESSURE BALANCE TYPE

Diameter Kecil hingga Diameter Super Besar 0.2 meter ~ 5.0 meter

Diameter Pipa dari Pipa Yang Diinstal

0.2 – 0.8 m	Diameter Kecil pipe-jacking Remote control- Tidak ada orang masuk ke pipa
0.8 – 3.0 m	Diameter Menengah & Besar Pipe-jacking Remote control or orang masuk ke dalam pipa
3.0 – 5.0 m	Diameter Super Besar Pipe-jacking or Shield-jacking
5.0 – 14.0m	Shield-jacking
14.0 – (17.45 m)	Shield-jacking

Untuk Diameter Dalam lebih dari 3 meter, Pipa dirakit di site proyek , diameter bisa sampai 5 meter.

Jacking Pipa

- Pipa Beton
- Resin pipa beton
- Pipa Vinyl chloride

Ketiga jenis ini umum digunakan untuk sistem pembuangan oleh pipa-jacking dan microtunneling di Jepang.

beton persegi panjang digunakan dalam instalasi box culvert.

Panjang Jacking dan Kapasitas

Panjang jacking Ultimate tergantung pada:

- Kapasitas pipa Jacking
- KapasitasThrust Wall
- Kondisi air tanah & tanah
- Metode penggalian & mesin sistem kontrol
- Alignment – kurvatur
- Sistem pelumasan
- Kapasitas dari Thrust Jack
- Intermediate Jacks (Nos. / Kapasitas)

Pelumas and over-cut untuk jacking panjang/belok

- Agar mesin dapat dikontrol, cutter head berputar menghasilkan over-cut kecil (gap annular) relatif terhadap diameter luar sebenarnya dari pipa yang di jacking.
- Selama proses jacking, annular gap terus secara periodik diisi dengan pelumas.
- Pelumasan dilakukan dalam rangka mensupport annular gap dan meminimalisir perubahan muka tanah atau menghindari longsor.
- Injeksi pelumas juga menurunkan gesekan antara pipa dan tanah sehingga bisa menghasilkan instalasi pipa jarak jauh.

Identifikasi Objek Penghalang

Kondisi tanah dan air tanah merupakan informasi yang sangat penting dalam pipa-jacking: Studi kasus, lubang percobaan (sampai kedalaman m 6 di bawah permukaan tanah) / sumur bor (lebih dari 6 m kedalaman di bawah permukaan tanah)

- Batu, kerikil, pohon, dan puing-puing konstruksi seperti tumpukan kayu, sheet-pile, utilitas yang ditinggalkan, beton, kayu, batu bata, dan benda logam.
- Berpotensi fatal apabila tidak ada akses di permukaan tanah untuk mengambil mesin atau menghancurkan penghalang.
- Mungkin perlu untuk memodifikasi alignment pipa, memerlukan ketentuan mesin khusus, memiliki ketentuan untuk recovery shaft atau mengambil langkah-langkah lain yang sesuai.
- Agar dapat mengadopsi pendekatan yang tepat , sangat penting untuk mengevaluasi kemungkinan menghadapi penghalang dan, jika tidak mungkin untuk menghindari penghalang, setidaknya perlu untuk menentukan sifat dan ukuran dari penghalang.

Over-cutting dan ground settlement

Over-cutting digunakan untuk memberikan celah kecil antara dinding bagian dalam dari tanah digali dan permukaan luar pipa.

Meskipun over-cutting lebih efektif untuk jacking jarak jauh dan jacking melengkung, over cutting yang terlalu besar akan membuat perubahan permukaan tanah yang berlebihan atau kadang-kadang longsor.

Pembaruan / rehabilitasi jaringan pipa lama

CIPP : Cured in Place Pipe Lining

untuk mengembalikan saluran pipa pembuangan yang rusak

SPR : Spiral Wound pipe lining technology

strip plastik ikat terus menerus ke dalam pipa yang ada

Pipe Replacement

Cut and Cover: Penggalian jalan mengarah ke waktu konstruksi, biaya dan dampak pada warga, masyarakat dan lingkungan.

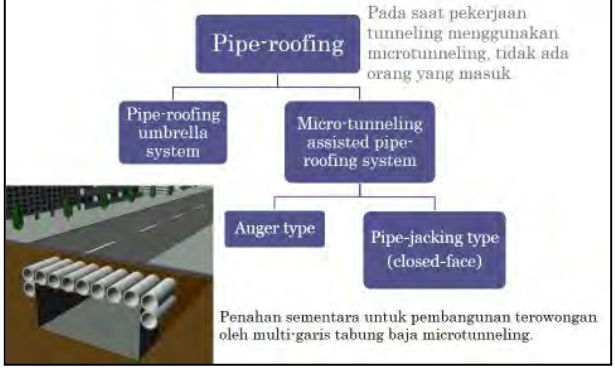
Trenchless-Pipe bursting-EXP

Pipe splitting

Pipe crushing

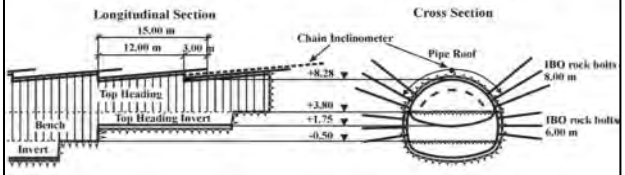
Pipe eating-Pipe replacer

Teknologi Pipe Roofing



Penahan sementara untuk pembangunan terowongan oleh multi-garis tabung baja microtunneling.

Sistem Pipe-roofing Umbrella



Digunakan untuk meningkatkan kekuatan tanah di depan terowongan. Berdasarkan tindakan lengkungan struktural dalam aksi sectional dan balok membujur.
Diameter pipa baja atau bar baja 50mm ke 100mm, relatif kecil.

Contoh dari sistem pipe-roofing

Di perkotaan konstruksi jalan tol bawah tanah dengan microtunneling sistem pipe-roofing
Pipa bagian persegi panjang yang digunakan.

Terowongan jalan tol dengan microtunneling sistem pipe-roofing.

kesimpulan

- Teknologi Pipa-jacking / mikro-tunneling jauh berguna untuk Indonesia.
- Microtunneling mengintegrasikan sistem penggalian dan pemindahan hasil galian oleh sistem remote control tanpa manusia masuk ke dalam terowongan selama operasi.
- Kondisi tanah dan air tanah merupakan informasi yang sangat penting dalam menentukan metode pipa-jacking / microtunneling.
- Berbagai mesin tunneling telah dikembangkan untuk berbagai kondisi geologi serta batu.
- Cutting Face harus didukung dengan mempertahankan tekanan slurry di cutter chamber dari tipe Slurry Pressure Balance Microtunneling.
- Penggalian cepat dan teknik remote control memerlukan sistem bimbingan elektronik canggih menggunakan sistem guide laser.
- Untuk jarak jauh dan tunneling melengkung, pelumas yang tepat dan sistem injeksi harus digunakan.
- Sistem pembaharuan pipa/ rehabilitasi sekarang digunakan untuk jaringan pipa tua.
- Pipe-roofing sangat berguna untuk membangun ruang bawah tanah yang rumit.