Activities in Japan Society of Civil Engineers (JSCE)

1. **Function and organization of Japan Society of Civil Engineers (JSCE)**
2. **Present status and possibility of TBM method in Japan as one of JSCE's activities on ILC project**

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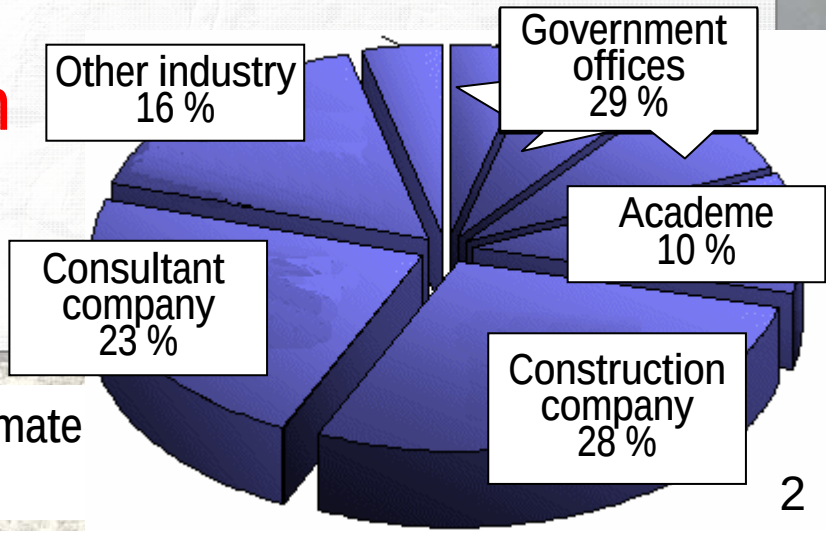
Japan Society of Civil Engineers (JSCE)

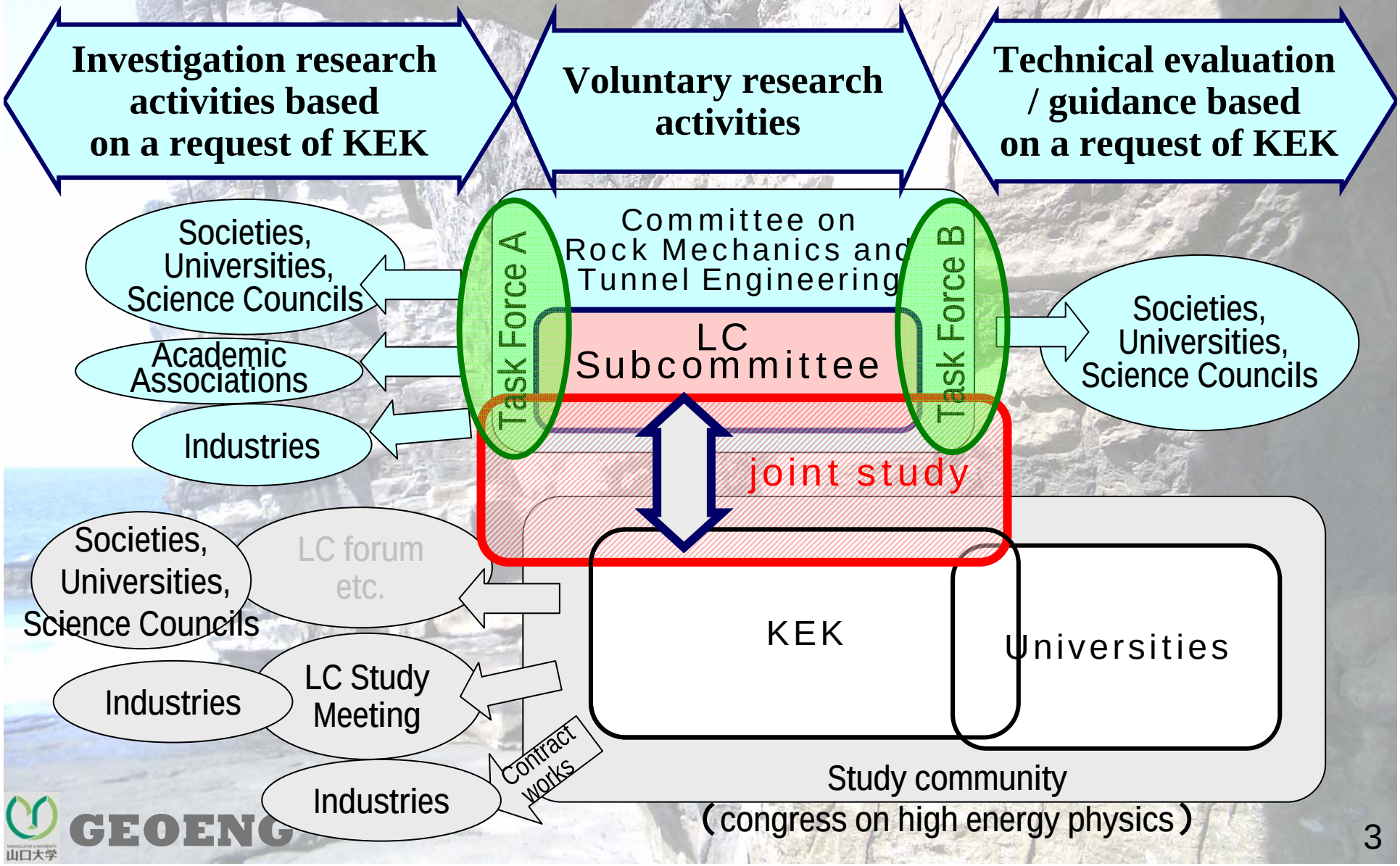
With the birth of the 21st century, JSCE has reconfirmed its goals to exert perpetual efforts

1) to propose an idea for social infrastructure development in the future from civil engineers' perspective,
2) to acquire a steadfast relationship of mutual trust with the society,
3) to promote scientific and technological researches/studies with a high degree of transparency, and
4) to evaluate public works from a neutral standpoint, and to reach a social consensus on those proper standards.



the JSCE membership has approximate 39,000 members at present

Activities of Committee in JSCE



LC Subcommittee in JSCE

LC subcommittee
on civil engineering issues for the ILC project, which consisted of the following working groups :

59 committee members **are scientists, researchers and engineers who specialize in rock mechanics, tunnel engineering, geology etc.**

Steering WG			Working Group
Chair Person、Secretary General	Chief	Secretary	**Planning and Risk Management**
	Chief	Secretary	**Geological Survey and Testing**
	Chief	Secretary	**Structure and Environment Design**
	Chief	Secretary	**Construction and Maintenance Management**
	Chief	Secretary	**Information Investigation of ILC**

Task Forces （e.g. Site Assess ）

LC Subcommittee on Civil Engineering Issues for ILC Project

Working Group

1) Steering Working Groups	Steer the activities of the LC subcommittee
2) Planning and Risk Management	Extract and study the problems on the plan and risk management of ILC to be solved
3) Geological Survey and Testing	Earth-quake & faults, ground water & environmental preservation, long-term displacement behavior, survey and testing methods
4) Structure and Environment Design	Design of large-scale openings (experimental hall), tunnels and shafts, and environment assessment
5) Construction and Maintenance Management	Study and propose suitable environmental condition, layout and construction method to minimize the cost and to reduce construction periods
6) Information Investigation of ILC.	Investigation of data and information on ILC

Underground Openings and Its Construction Methods

Underground openings are divided in the following 4 kinds:

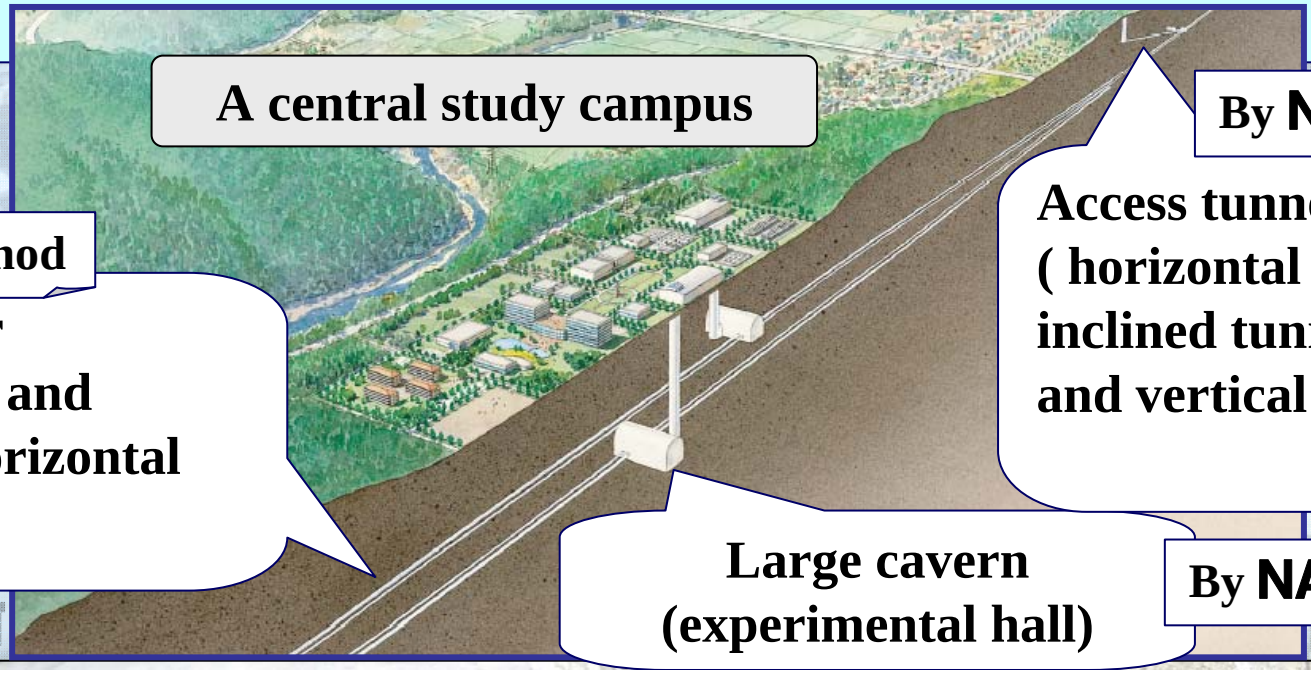
1) Access tunnels **by NATM and so on.**

2) Horizontal tunnels **for accelerator and utilities by TBM method**

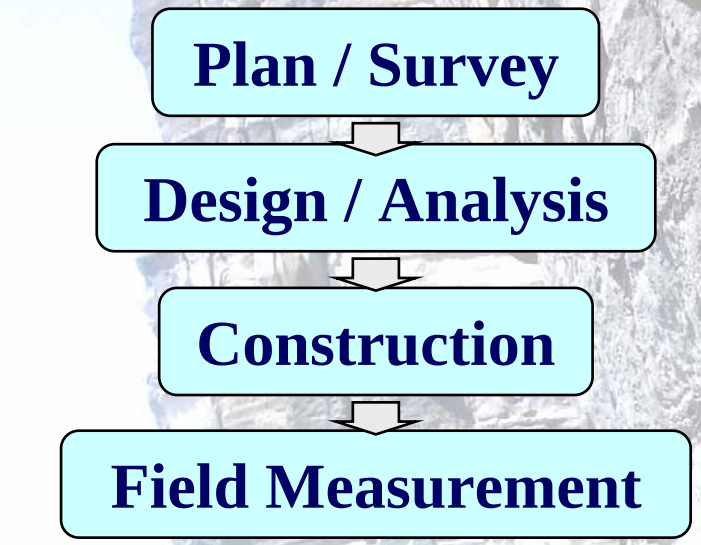
3) Large cavern **for an experiment hall by NATM**

4) Working tunnels **for underground construction works by NATM**

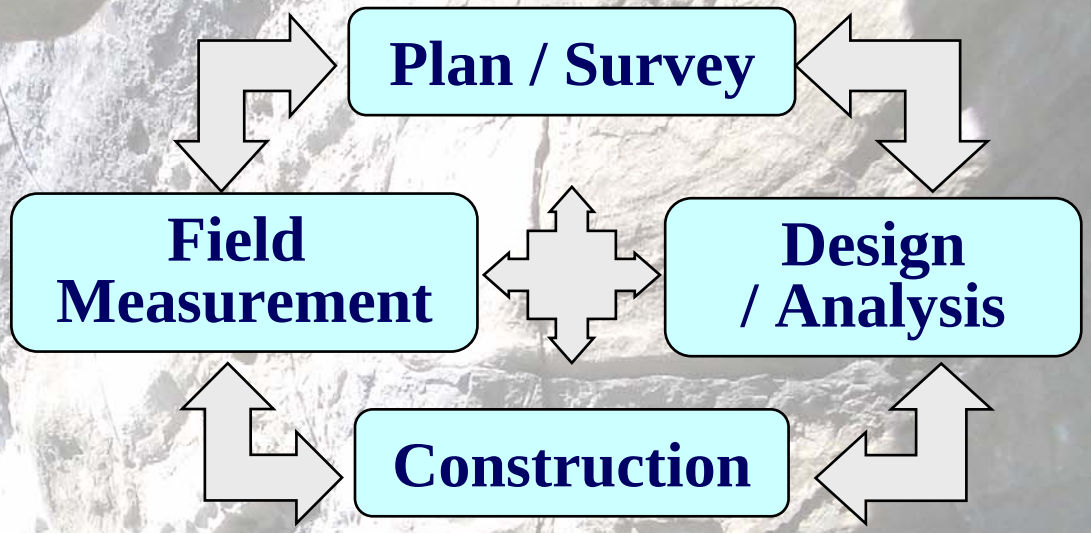
Underground openings except for horizontal tunnels will be constructed by rock bolts and shotcrete method sometime called NATM (New Austrian Tunneling Method) in Japan.



Construction Management by Field Measurement



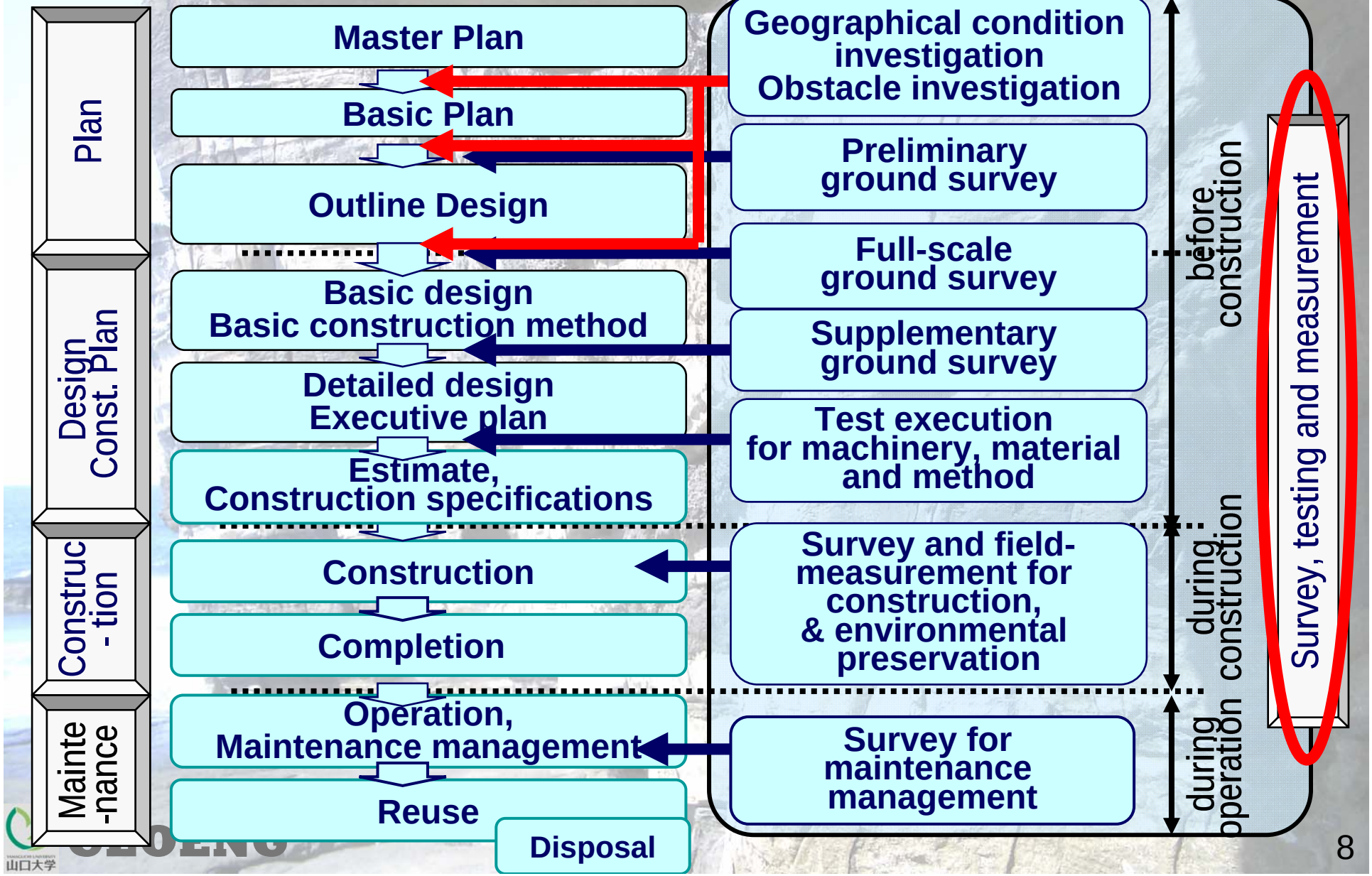
Steel structure like a bridge



Geo-structure like underground opening

Survey & Testing system	**Survey and testing method, Data evaluation system**
Measurement System	**Measurement device and system, Construction management by feedback system, Data processing system**
Evaluation System	**Statistics analysis system, Design analysis system(stress deformation, ground water flow, heat conductivity), Back analysis system, Experts system construction management**

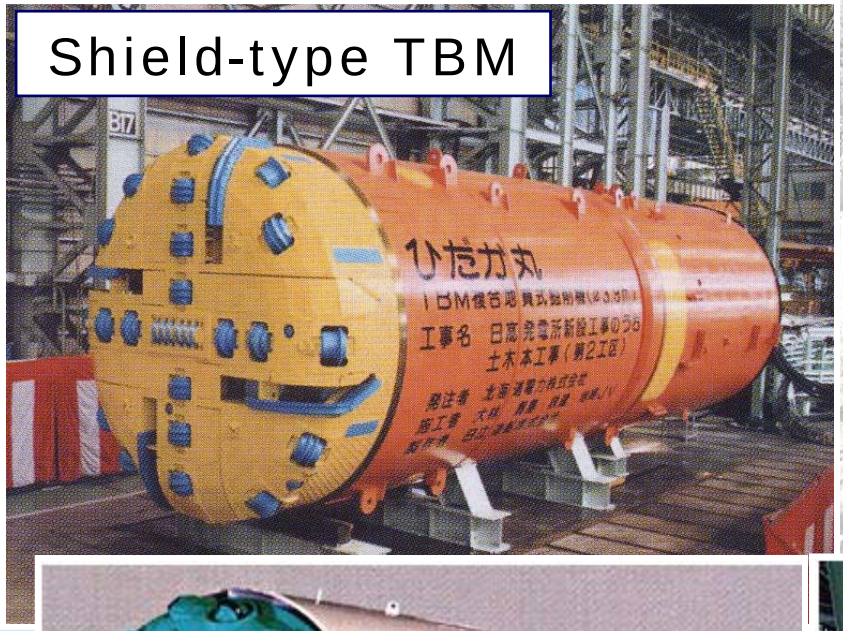
Technologies of Civil Engineering



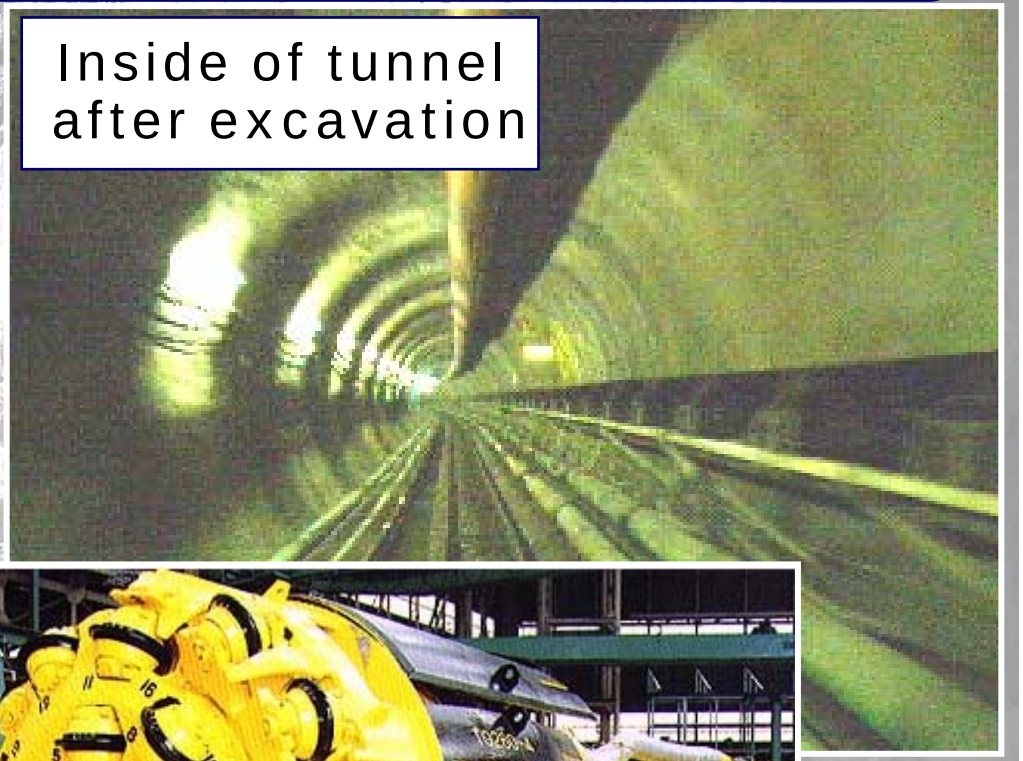
Tunnel Boring Machine (TBM)

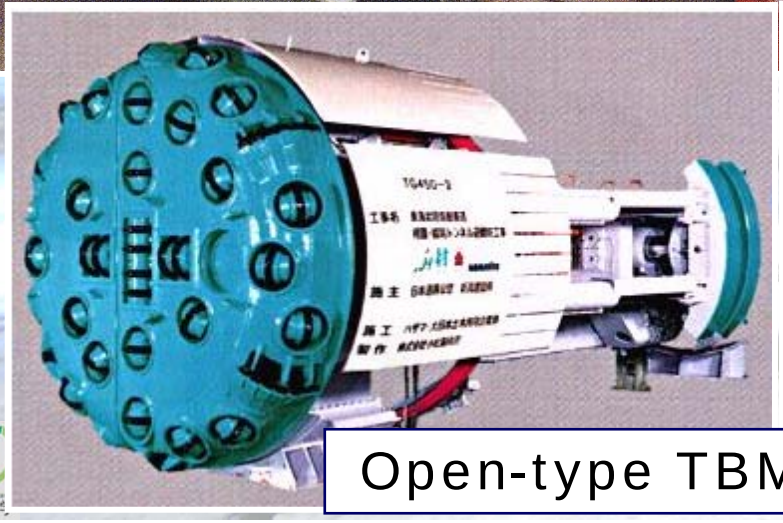
TBM of which a face is excavated by huge cutter-head makes rapid construction possible.

Shield-type TBM



Inside of tunnel after excavation

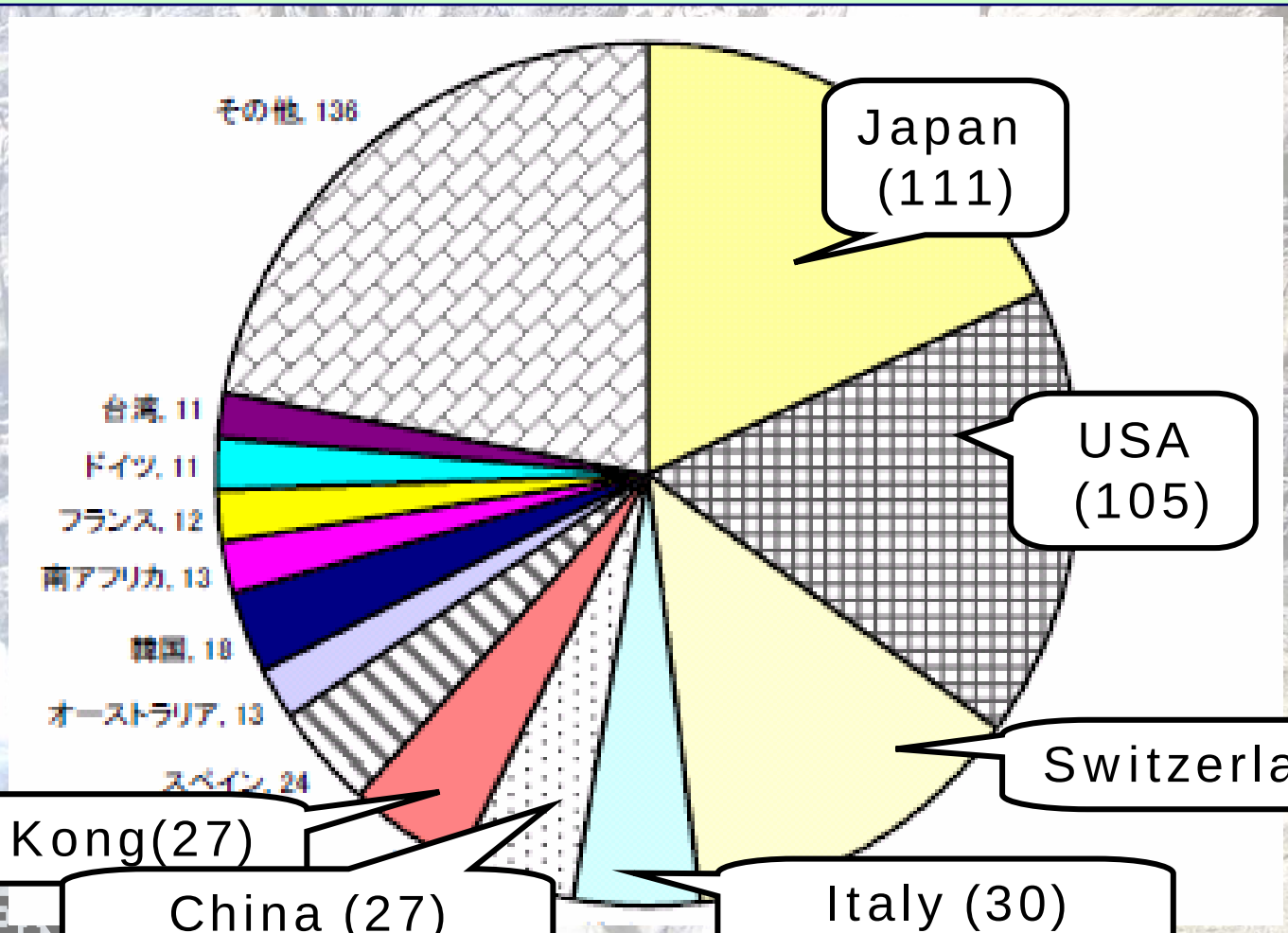




Open-type TBM

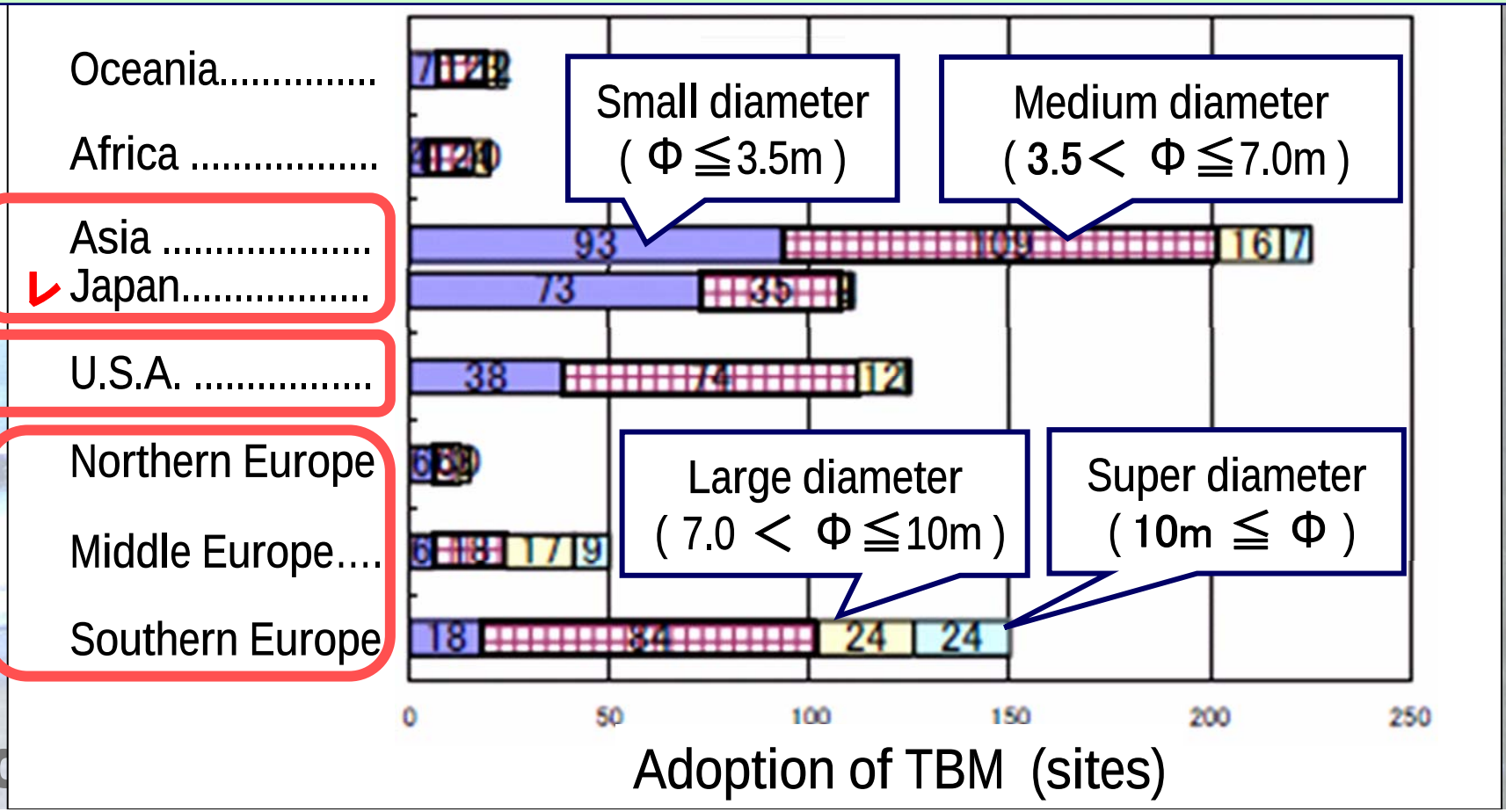
Application Results of TBM

This graph which is made from international journals and documents offered from TBM makers shows the execution results of TBM in each country after 1986.

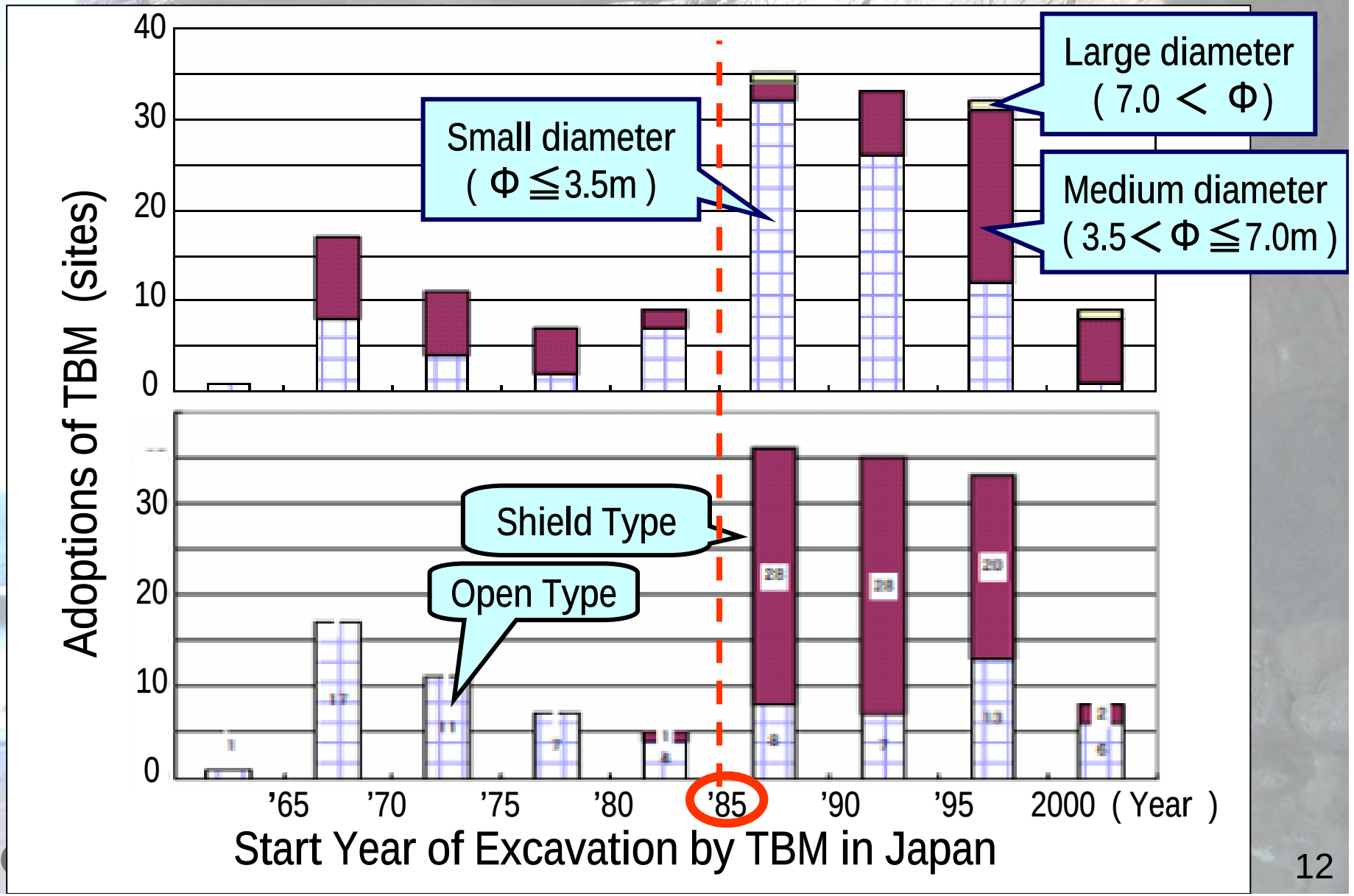


Execution Results of TBM (Diameter)

In Europe, TBMs having various diameters are adopted for construction. On the other hand, in Asia and USA, there are many adoptions of medium diameter model, but there are not many applications of that size in Japan.

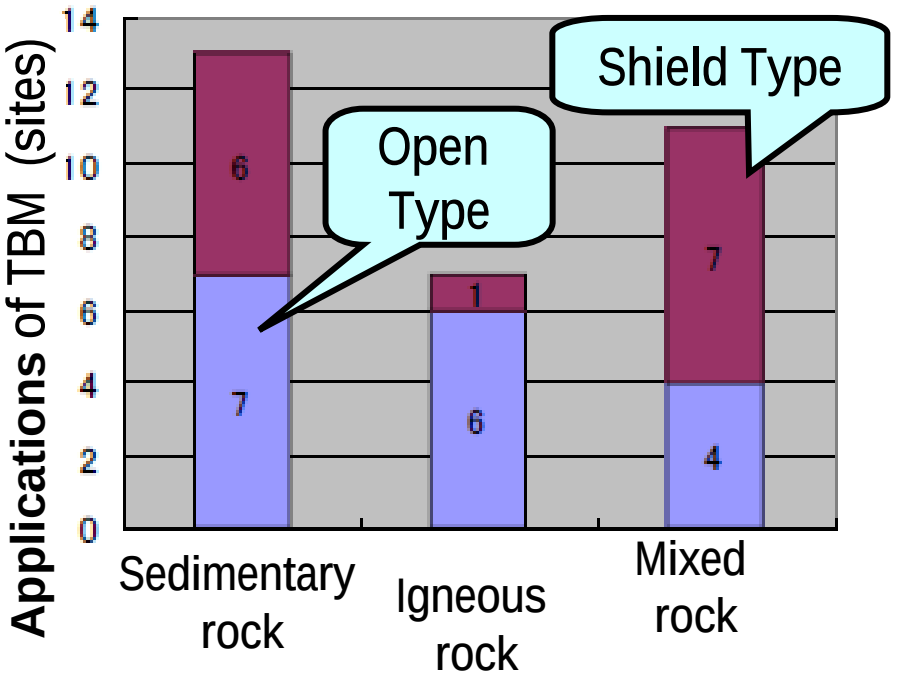


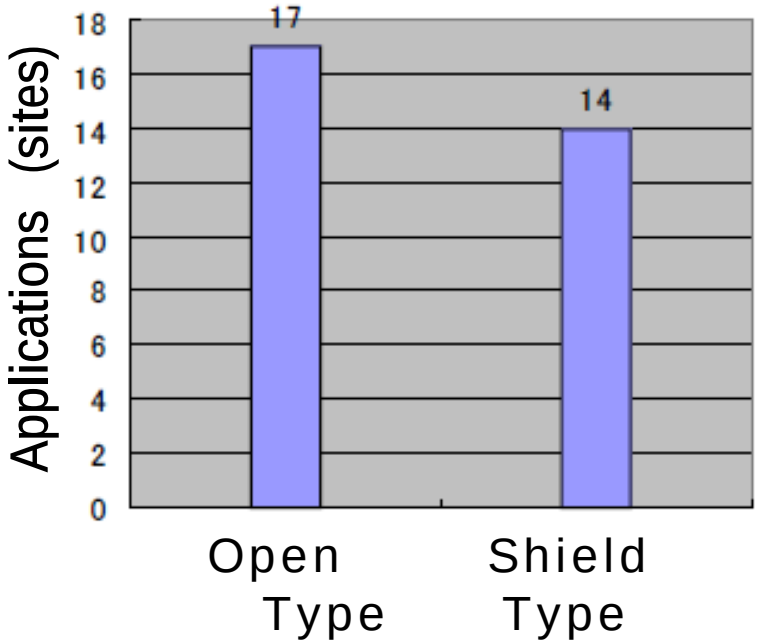
Adoptions of TBM in Japan (Diameter & Type)



Rock Classification and TBM Type

The adoption ratio of open type TBM is high in igneous rock class, and there are many shield types slightly in mixed rock class. But in a sedimentary rock class, both TBM types are selected to the same degree.



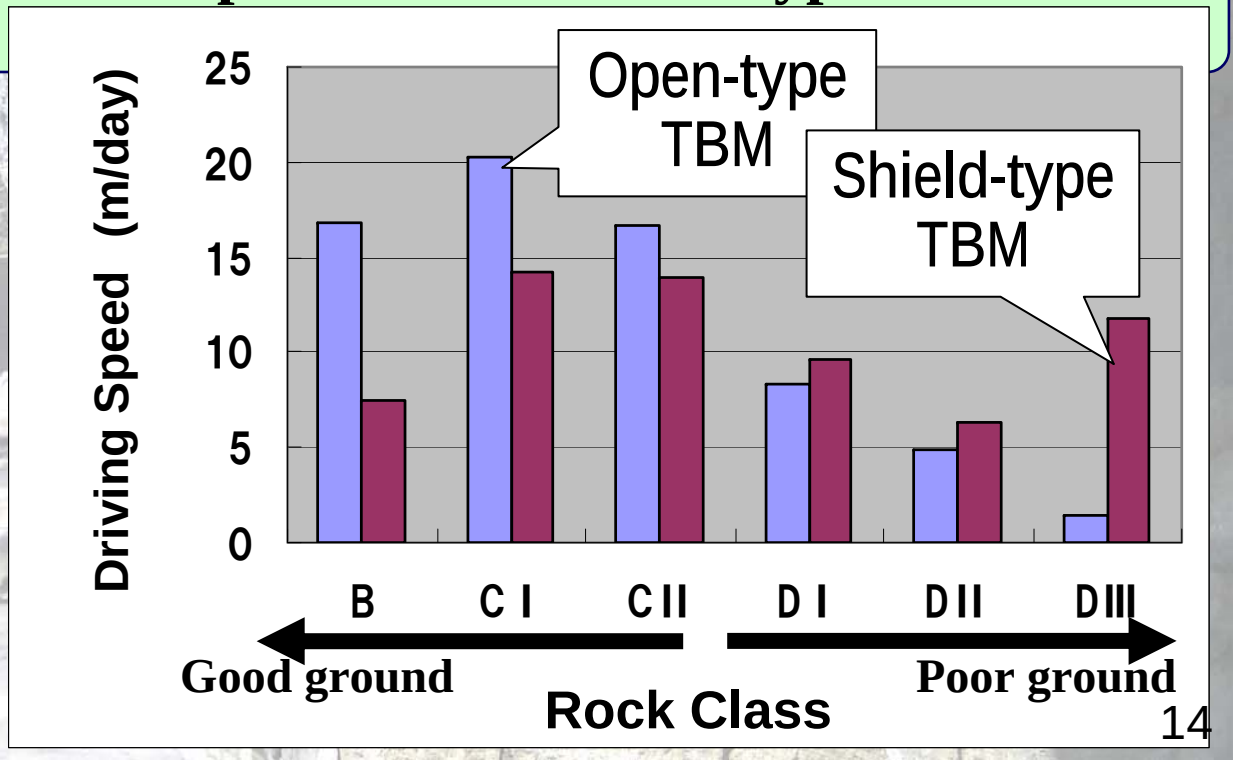


Rock Classification and TBM Type

Driving Speed of TBM and Rock Classification

Because driving speeds of two TBM types are affected by ground condition, both results in the left table are unable to be compared simply. But the right figure shows that open model becomes faster in a good ground such as B - C Ⅱ class, and slower in the poor ground such as D Ⅰ class in comparison with shield type TBM.

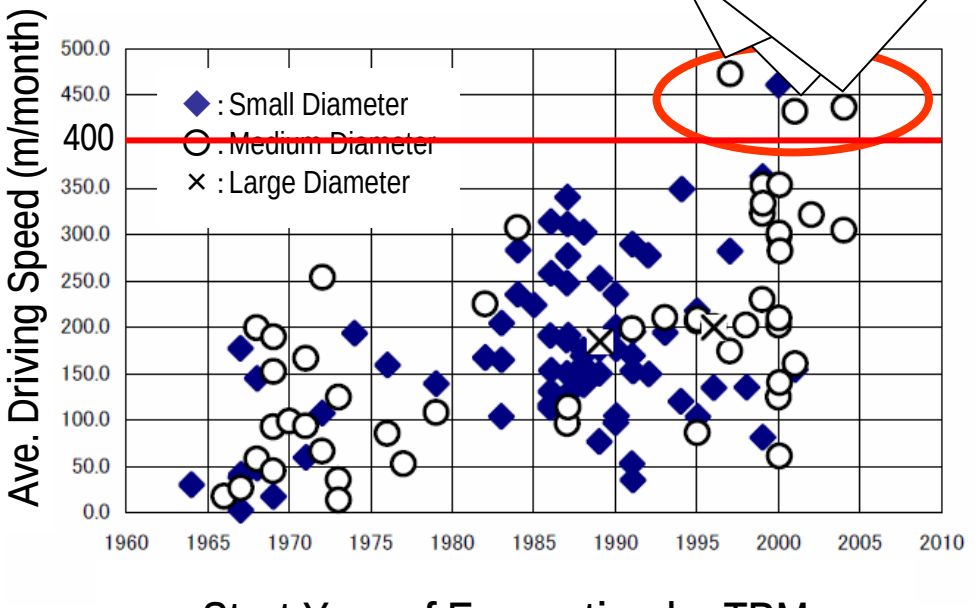
TBM type	Average Driving Speed (m/month)
Open-type	356.2
Shield-type	260.6



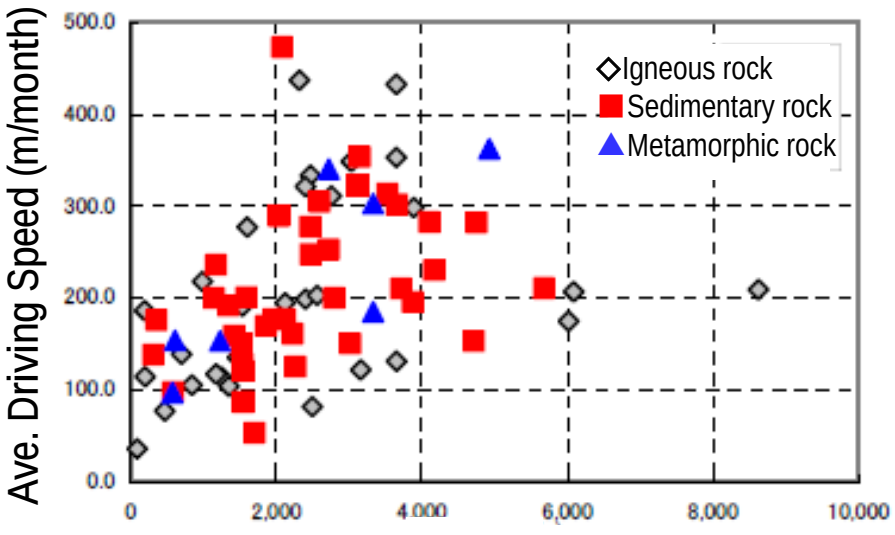
Driving Speed of TBM

This figures show that in the late years that have begun to adopt consecutive belt conveyors for mucking out, examples of fast average driving speed increase.

Sites adopting belt conveyer system



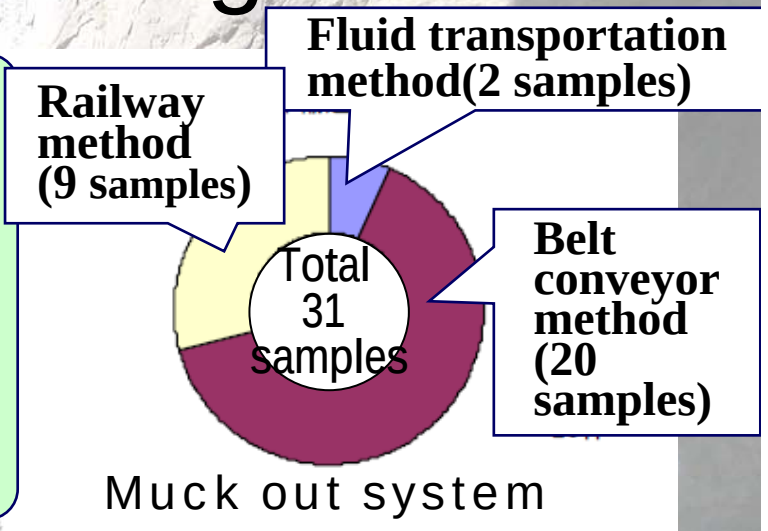
Start Year of Excavation by TBM



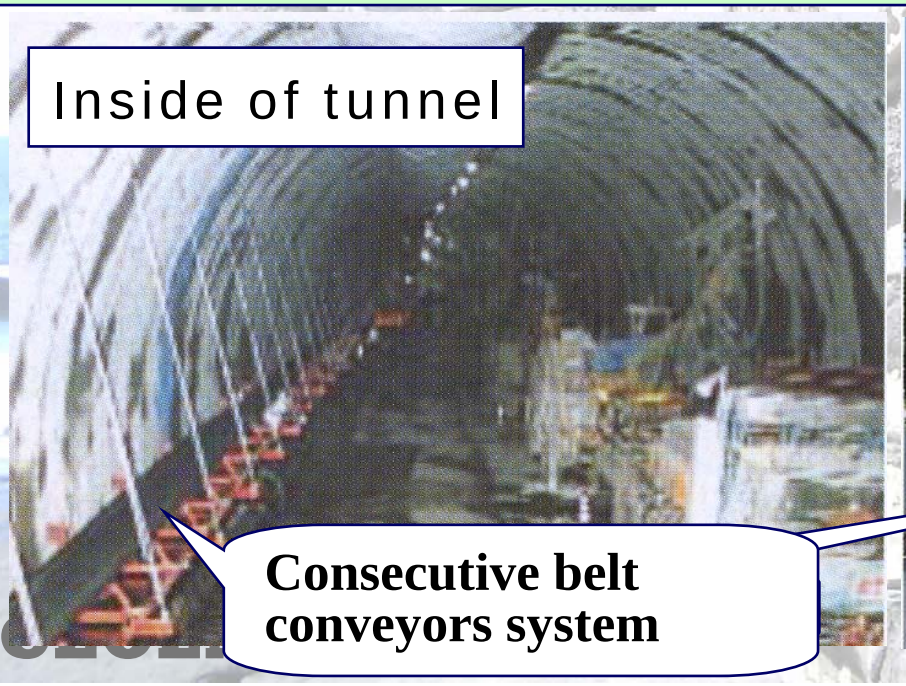
Excavation Distance by TBM

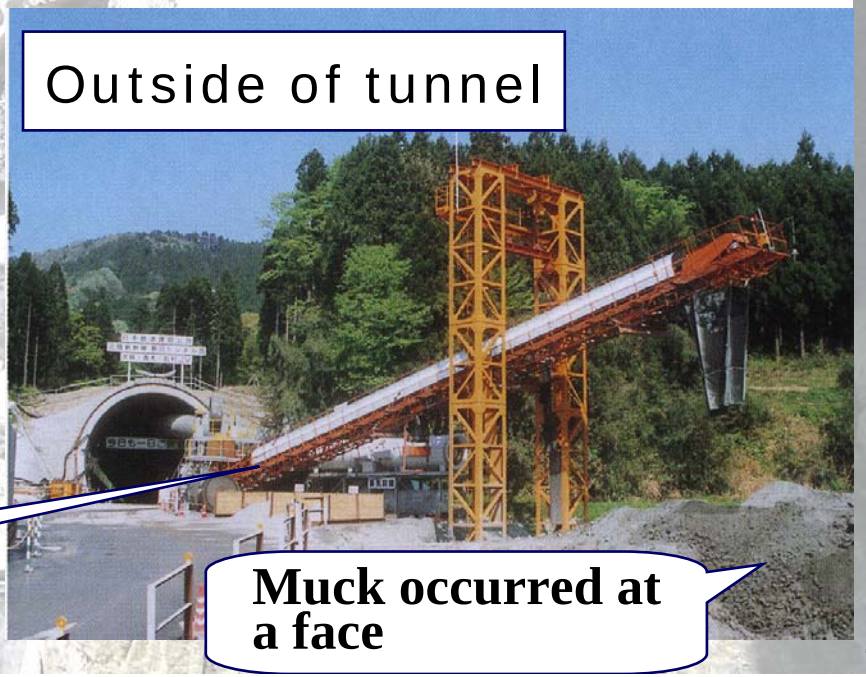
Consecutive Belt Conveyors System for Mucking Out

Belt conveyors system, which automatically carry muck occurred at a face to the outside of tunnel without affecting excavation and support works, can make driving speed of TBM fast.



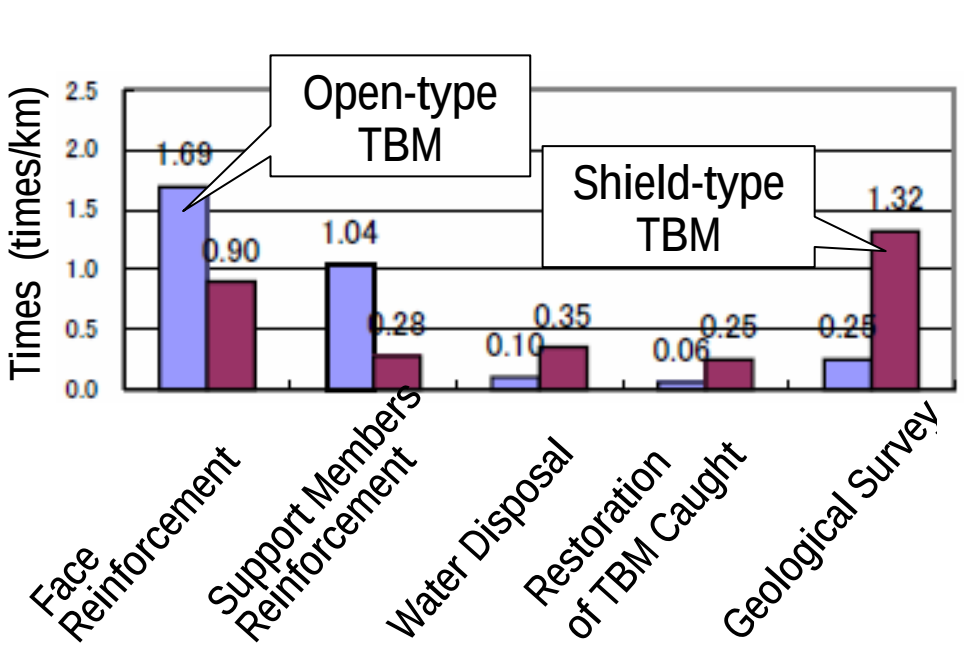
Muck out system

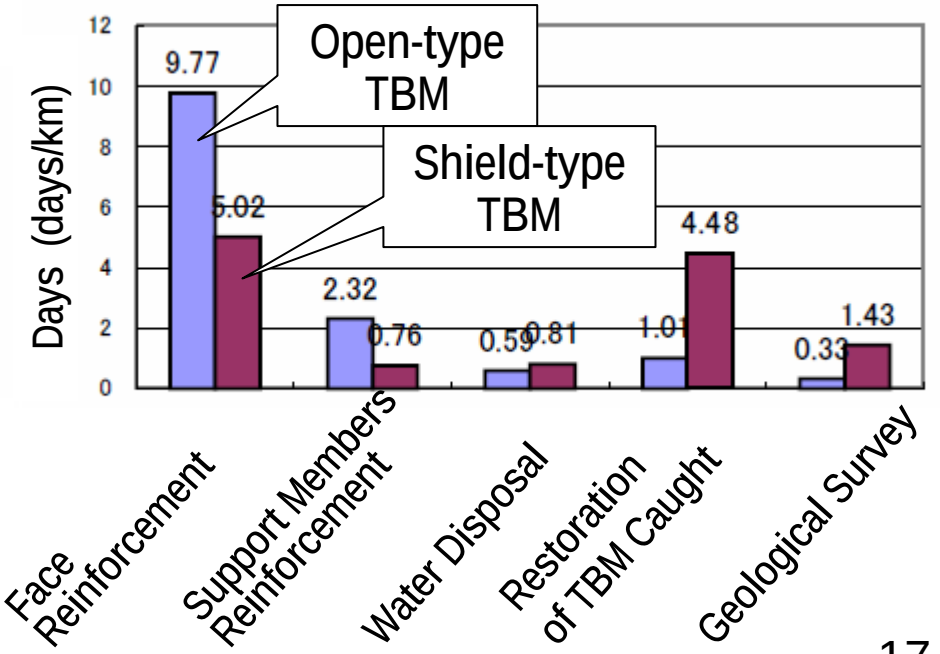




Construction Loss by Troubles in TBM Method

Open model is often stopped because of measures to face collapse and reinforcement of support members. On the other hand, shield model often stopped to survey the ground condition. In addition, it's found that a restoration takes time when TBM is caught by squeezing or swelling rock.





Simulation of Driving Speed of TBM in Japan

As for driving speed of TBM in good ground condition, the achievement of over 500 m/month is almost possible in Japan, if it's taken a work system of 3 shift and 30 work-days/month such as Europe and U.S.A..

Rate of Rock Class (%)	CⅠ	50	45	45	40
	CⅡ	50	50	50	50
	DⅠ	0	0	0	0
	DⅡ	0	5	0	0
	DⅢ	0	0	5	10
Open Type TBM	m/month	579	515	353	254
Shield Type TBM	m/month	556	521	539	524

Note) Driving speeds are calculated by conversion of 30 work-days/month and 3 shifts from past data of TBM having 4.5m and 5.0m diameter.

Conclusion

- **As for a open type TBM, if it come across the geological condition that is considered at the plan stage, economic and rapid tunnel construction is possible, but encounter with the worse ground than the assumption will bring serious influence such as huge expenses and much delay of construction.**
- **Therefore, for plan and design of tunnel by TBM method, collection and analysis of information about a geological feature at a construction site are very important.**
- **And a construction plan has to be made in the next step in consideration of a total standpoint including cost, periods and quality of construction.**


End