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ICT-driven Earthwork of Roads and Rivers

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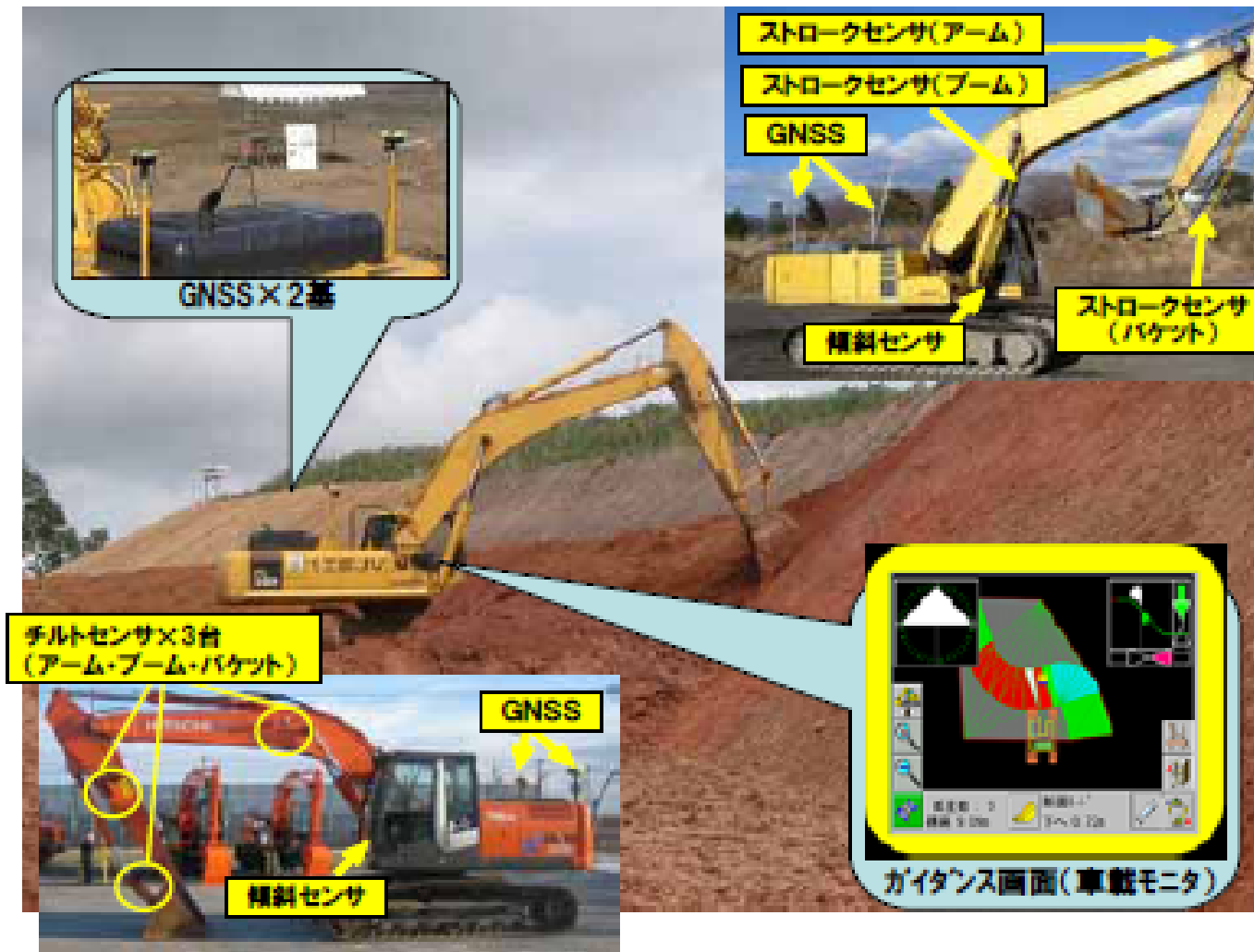
Computerized Construction

- In Japanese, the term “computerized construction” literally means “informatized construction (情報化施工)”, which is ambiguous.
- For some decades in the 20th century, “informatized construction” meant a flexible construction method based on site measurement, feedback to design, back-analysis, change of work methods for tunnels and large scale underground structures.
- Uncertainty of underground situations.
- Firstly proposed as “Construction by Observation” by Terzaghi and Peck in 1948.

Current “Computerized Construction”

- Automatic or semi-automatic construction machine control (MC) and machine guidance (MG) using 3D design model data, Total Stations (TS), Real Time Kinematic – Global Navigation Satellite Systems (RTK-GNSS) and 3D motion sensors (gyro-sensors).
- Improving quality and efficiency of inspection of as-built forms of earthwork using using 3D design model data, Total Stations (TS), Real Time Kinematic – Global Navigation Satellite Systems (RTK-GNSS) and various sensors.

Machine Guidance System for Backhoes



油圧ショベルのマシンガイダンスシステム技術(例)

Machine Control System for Graders



グレーダのマシンコントロール技術(例)

The diagram illustrates a three-step workflow for construction management:

- ①基本設計データ作成ソフトウェア(パソコン)**: Basic design data creation using PC software.
- ②出業形管理用トータルステーション**: Construction management using a Total Station (TS) and a handheld electronic device (電子野帳).
- ③出業形標準作成ソフトウェア(パソコン)**: Construction drawing creation using PC software.

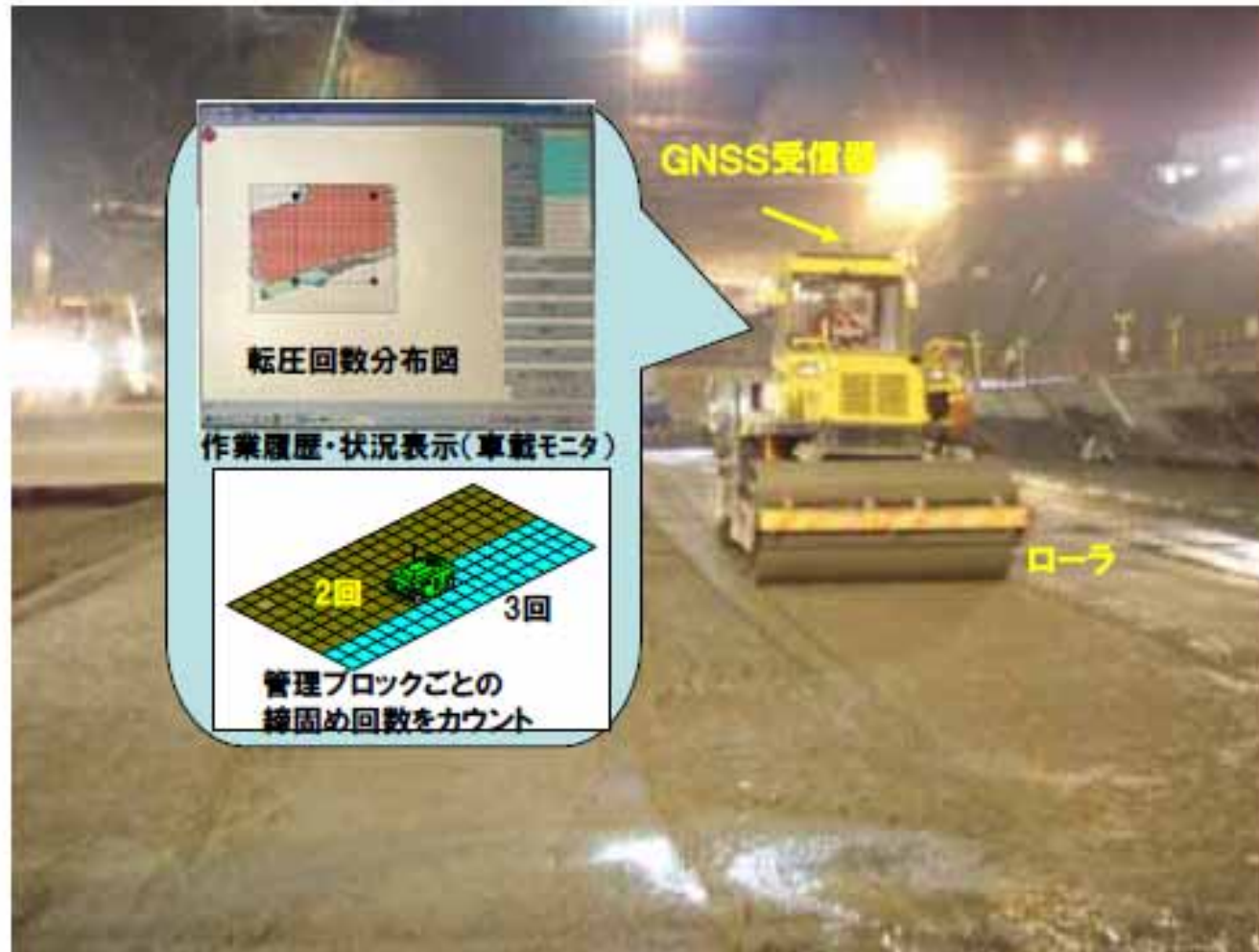
The workflow involves the exchange of data in XML and PDF formats between the PC and the handheld device.

出業形管理支援画面 (Software Interface):

断面 H=10.412m (1.1m)	
●標高●	FL: 0.000(m) 測定: 0.000(m) 0.004 m 差
●距離●	設計: 右1.000(m) 測定: 右1.017(m) 0.017 m 差

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Inspection of Quality of Compaction Using Trajectories with GPS



ローラの軌跡管理による面的な品質管理技術(例)

Quality Control Using GNSS



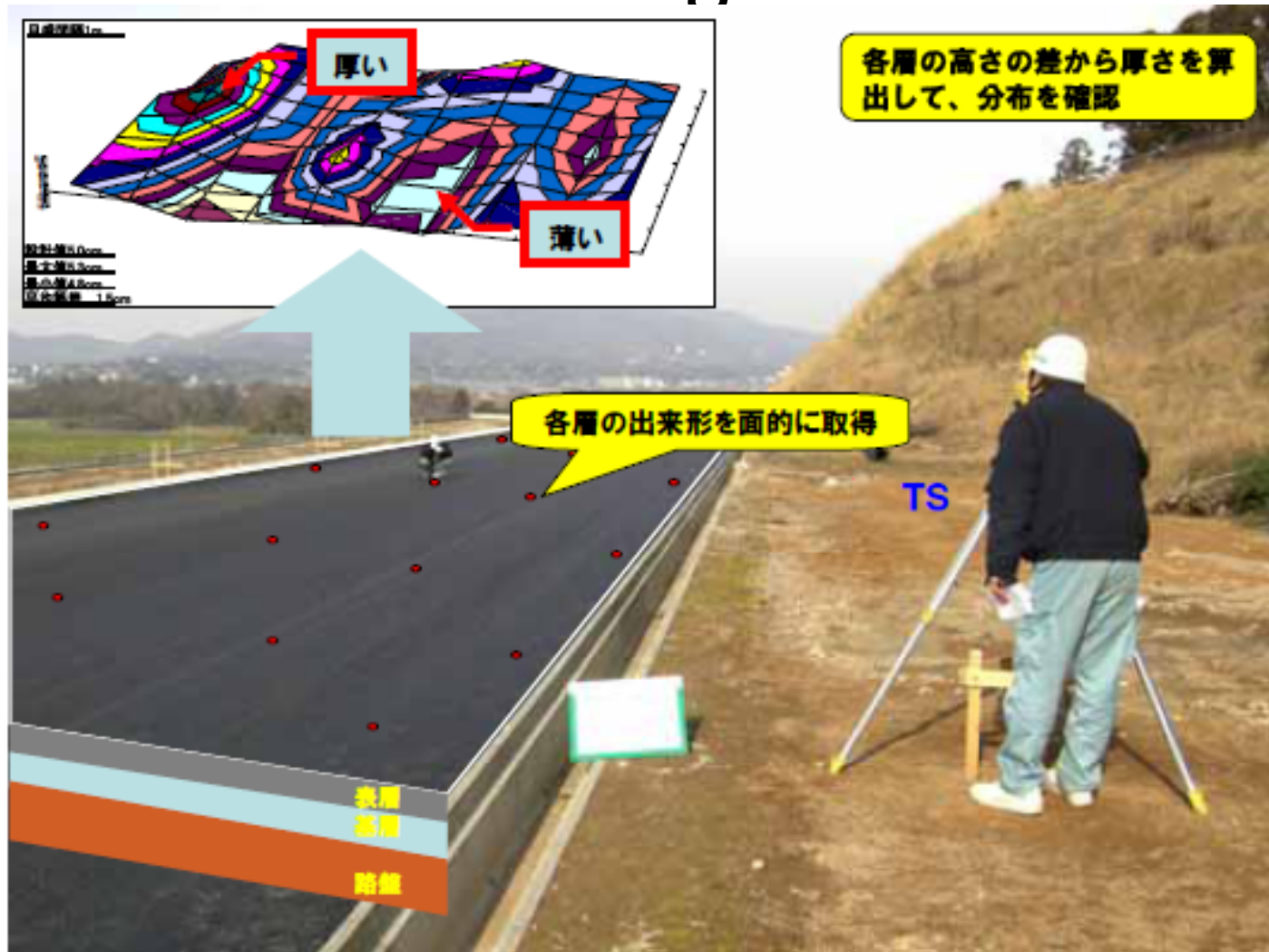
ブルドーザによる面的な品質管理技術(例)

Quality Control Using GNSS and Accelerometers



振動ローラの加速度応答による面的な品質管理技術(強度)(例)

Inspection of As-Built Forms of Roads Using TS



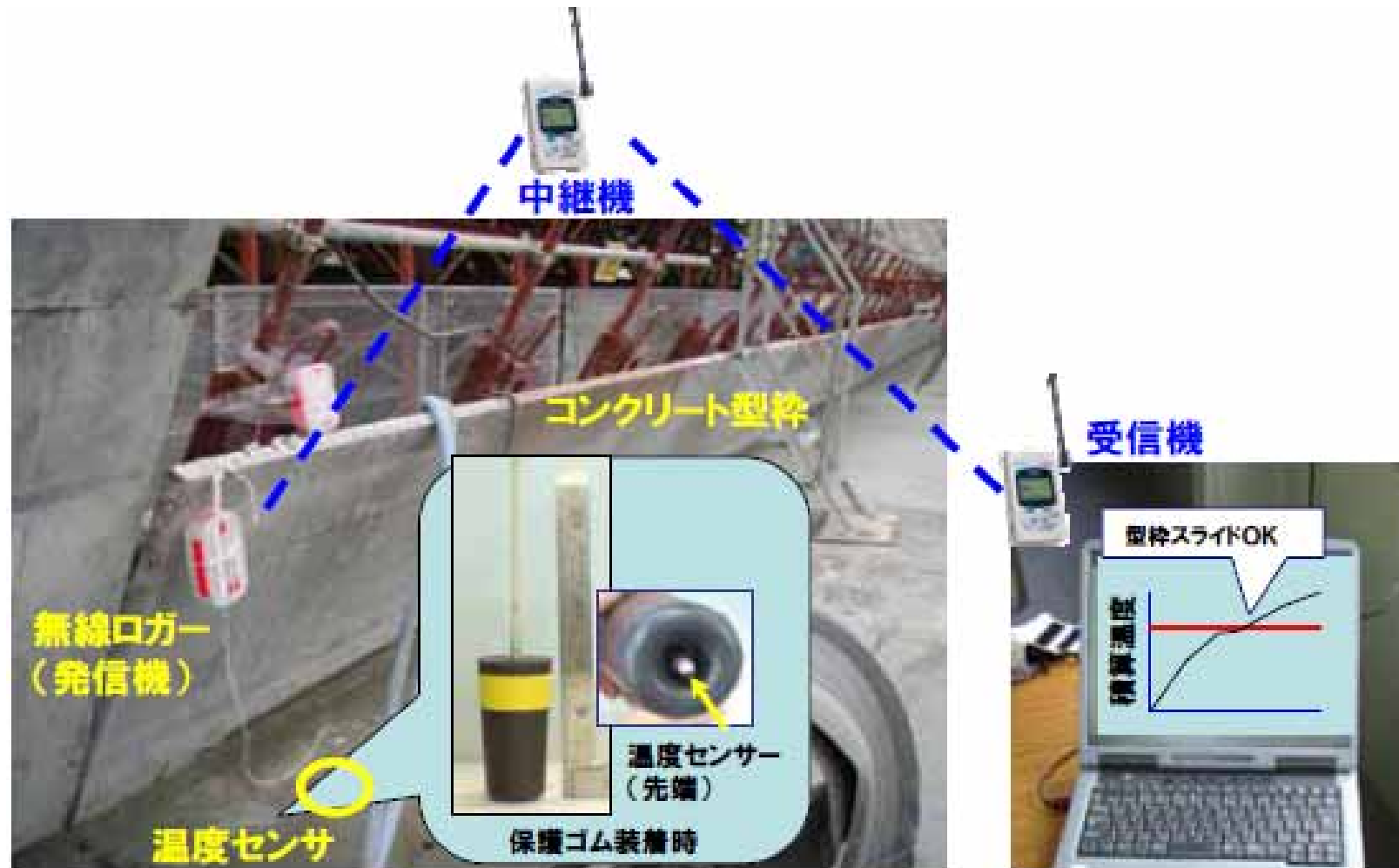
TSを用いた出来形確認技術(厚さ)(例)

Quality Control Using GNSS and Noncontact Infrared Thermometers



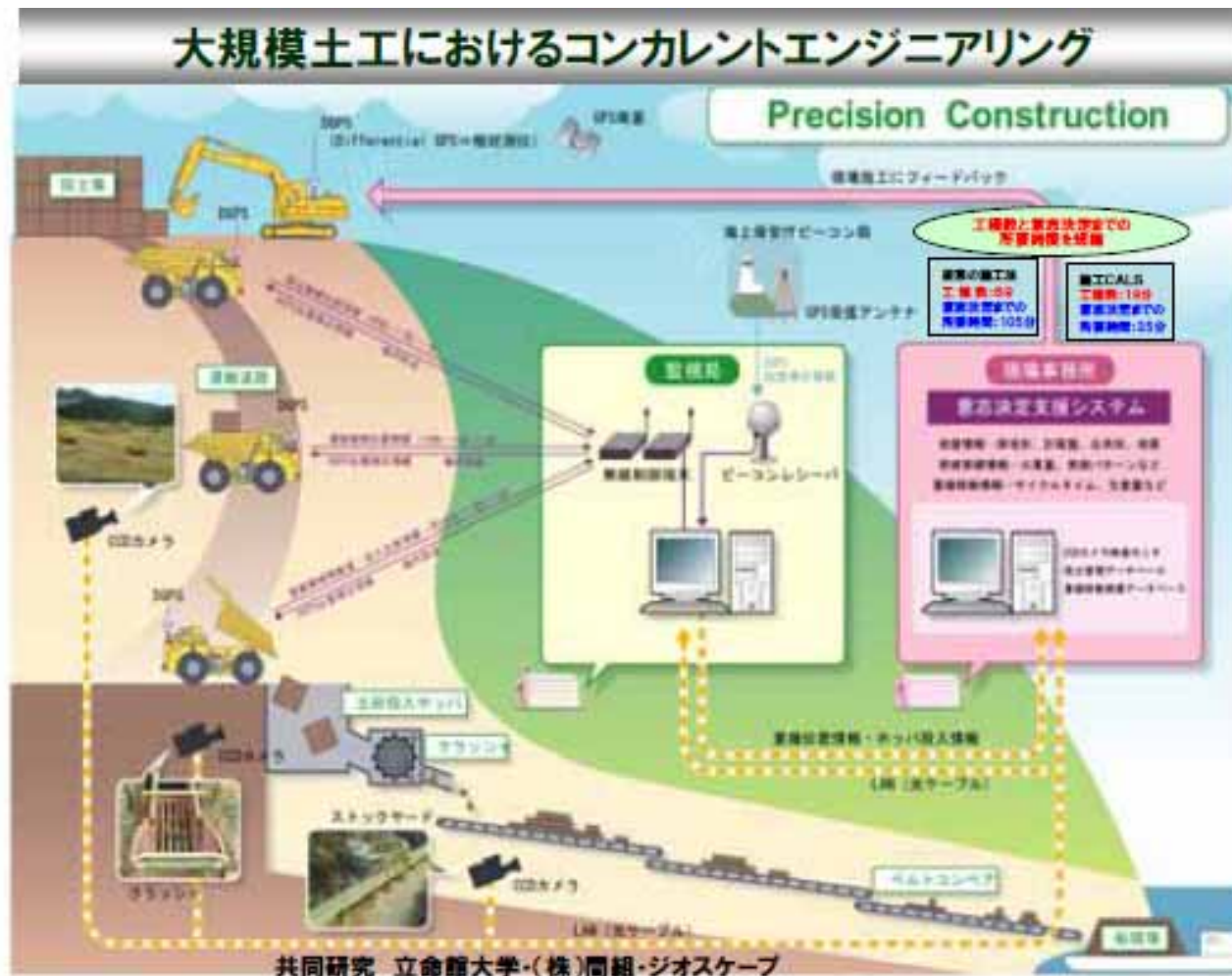
非接触赤外線温度計を用いた面的な品質管理技術(温度)(例)

Quality Control of Concrete Using Wireless Thermometers



無線付き温度計を用いたコンクリートの品質管理(積算温度)(例)

Precision Construction Using Operation Records of Construction Machines and Facilities



建設機械や生産設備の稼働記録を用いた精密施工管理技術(例)

Council for Promotion of Computerized Construction, Ministry of Land, Infrastructure, Transportation, and Tourism (MLIT)

- Started in February 2008.
- Strategy for Promotion of Computerized Construction was announced in July 2008.
 - The computerized construction method will be used for all large scale road and river earthwork projects from 2010 and for all small to medium scale road and river earthwork projects from 2012.
 - Logistics of special devices will be facilitated.
 - Workers will be trained to learn how to use special devices.

Background

- Labor productivity of construction industry is about half of that of manufacturing industry.
- Compared to the US and advanced European countries, Japan is behind in terms of adoption of the computerized construction method.
- The field of public construction has been the target of criticism for a long time in Japan especially by the mass media.
- Japanese construction companies do not perform well in foreign countries.

Demonstration and Actual Projects

- The Computerized Construction Method has been employed in many projects in Japan for demonstration and for actual projects.
- Questionnaire showed that many people involved feel the advantages of the computerized construction method. On the other hand, many complained for some reasons.
- Growing pains (labor pains) when doing something new.

Road 3D Data Models

- Design data: 2D drawings (SXF)
- Converting 2D drawings to 3D model data by a system developed by Japan Construction Mechanization Association.
- 3D data:
 - Road Centerline data: Mainly for inspection by the government.
 - LandXML: Mainly for machine guidance and machine control.

Issues for Future Work

- Design data is still 2D. Converting 2D data to 3D model data takes time. Why not 3D design instead of traditional 2D design?
- Inspection of as-built forms by the designated points using TS takes time. Why not many free points? Why not using a laser scanner?

Thank you for your attention.