Theme 4. i-Construction and new technology

Sophistication of Construction with ICT

Precise Management in Construction

Introduction of Construction Robots
Construction of infrastructure in Japan which has pursued efficiency

Efficient system to construct structures with a level of quality within a short period
Systematizing design
Settling criteria
Completing manuals

Growth of infrastructures in Japan (white paper on Japanese construction)

Excess dependence on the specified rules or manners

Unavoidable excess input of labors, materials, etc.
Precise management in construction sites

Construction jobs generally have to include some unexpected factor.

Flexible change of the original plan corresponding to the real conditions

Planning with margins

Optimization: Saving labors and materials, etc.
Example: Precise management in a large size earthwork

Precise Management in Earthwork

- **MGPS**
- **GPS satellite**
- **Site office**
  - Support system for engineers’ decision making
  - Monitors for CCD cameras
  - Database for mining management
  - Database for machine operation

- **Japan Coast Guard beacon station**
- **GPS antenna**
- **Feedback to construction**
- **Information for correcting location**
- **Radio control terminal**
- **Beacon receiver**
- **Information on construction**
- **LAN (optical cable)**
- **Belt-conveyor**
- **Ship loading**

- **Minning site**
- **Hauling road**
- **CCD camera**
- **Soil hopper**
- **Crusher**
- **Stockyard**
- **CCD camera**
- **CCD camera**
- **LAN (optical cable)**

- **DGPS**

Example: Precise management in a large size earthwork
Effects of Precise Management in Earthwork

Production volume per day

Conventional method : 100%

Increase of Productivity
Reduction of Environmental Impact

CO₂ emission volume per cubic meter of production volume

Go together through Precise Management
Introduction of Construction Robots
- Comparison with Factory Automation (FA) -

**Manufacturing**
- Form and materials are clearly specified in design.
- Working environment is stable because of indoor jobs.
- Working objects come to robots by themselves on a conveyer.

**Construction**
- Materials are soil and rocks and thus their properties are variable
- Outdoor working conditions are much affected by weather
- Machines must arrive at working objects in a huge field.

Construction robot should have a function to determine its own action flexibly according to the situation of each construction site.
Robots in Maintenance

Drain pipe inspection

Checking the bridge slabs

Robots in Recovery from Natural Disaster

Unmanned Construction

UAV
Evolution of Construction Robots

- Partially automatic machine
  - Practical use
  - Awareness of objects
  - Manipulator control
  - Estimation of objects
  - Awareness of position
  - Guidance
  - Safety control
  - Group control
  - Partially automatic machine

Construction Machines ➔ Construction Robots
Gradual Evolution of Construction Robots

**Autonomous Robot**
- Machines evaluate conditions, environments and determine the way of controlling machine
- Machines control itself automatically

**Judgement function**

**Unmanned Construction**
- Operators evaluate conditions, environments and determine the way of controlling machine
- Operators control machines remotely from separated place

**Advanced control function**

**Construction Machines**
- Operators evaluate conditions, environments and determine the way of controlling machine
- Operators control machines on vehicles
System consisting with plural different machines which do their jobs corroborating each other. Each machine can do its own jobs, while grasping the information on surrounding circumstance, the working object, the move of other machines and determining the optimum control way of itself.
Achievement of Autonomous Construction Robots

Next Generation Production System in Construction by Autonomous Machines

Development of A⁴CSEL System

By Kajima Co. Ltd.
Thank you for your kind attention