Assembling wall panels with robotic technologies

Frans van Gassel & Pascal Schrijver

Introduction

- Introduction
- Assembling Wall Panels
- Robotic Technology
- Robot and Curtain Wall
- Integration
- Goal
Introduction

The problems of (dis)assembling curtain wall panels at the construction site

• Neither safe nor labour-friendly
• Climate conditions make production times uncertain
• Taking a big part of the capacity of the tower cranes.
• Difficult to find people
• Curtain Walls are replaced at an early stage

Assembling Wall Panels

Rembrandt Tower in Amsterdam

Wall panel assembly steps
Assembling Wall Panels

1. Wall panels are transported to the floor where they are required.
2. Wall panel depot on the floor where the panels will be installed.
3. Wall panels are moved outside.
4. Wall panels are connected to tower crane.
5. Wall panels are assembled.

Introduction - Assembling Curtain Wall Panels - Robotic Technologies - Robot and Curtain Wall - Integration - Goal

Assembling Wall Panels

SADT diagram

Wall panels are manufactured at the factory. Wall panels are transported to the construction site. On the construction site, wall panels are transported to the depot on the floors. The wall panels are moved to the outside. The wall panels are transported to the assembling place. The wall panels are assembled.

The assembling points are measured and connected. The assembling points are measured and connected.

Labor, Factory, Truck, Labor, Tower Crane, Labor, Tower Crane, Labor, Tower Crane.

Introduction - Assembling Curtain Wall Panels - Robotic Technologies - Robot and Curtain Wall - Integration - Goal
Assembling Wall Panels

SADT diagram

Wall panels are manufactured at the factory
Wall panels are transported to the construction site
On the construction site, wall panels are transported to the depot on the floors
The wall panels are moved to the outside
The wall panels are transported to the assembling place
The wall panels are assembled
Complicated process/ with problems for every step

Use of Robotic Technology in assembling of wall panels

Human control
Assembling Wall Panels

SADT diagram

Wall panels are manufactured at the factory

Wall panels are transported to the construction site

On the construction site, wall panels are transported to the depot on the floors

The Wall panels are moved to the outside

The wall panels are transported to the assembling place

The wall panels are assembled

The assembling points are measured and connected

The assembling points are measured and connected

Introduction - Assembling Curtain Wall Panels - Robotic Technologies - Robot and Curtain Wall - Integration - Goal
Assembling Wall Panels

SADT diagram

Wall panels are manufactured at the factory

Wall panels are transported to the construction site

On the construction site, wall panels are transported to the depot on the floors

The wall panels are transported and assembled

Curtain wall

Robotic Technology

Material

Labor

Factory

Labor

Truck

Labor

Tower Crane

Measure and connect assembling points

Assembling Wall Panels

The possibilities for depots on the construction site if we use robotic technologies

Reduce the load on the capacity of the tower crane

Assembly from depots A and B without using the tower crane
Robotic technologies

Robotic technology at the moment

Mini-actuators

Sensors

Volume of 50 mm³

Robotic technology in the construction industry

Robotic technology is being used in existing methods.

Power trowelling of concrete

Laying sand-lime bricks
Robotic technologies

Robotic technology in the construction

Improve the equipment

Product stays the same !!!!

For example

Introduction - Assembling Curtain Wall Panels - Robotic Technologies - Robot and Curtain Wall - Integration - Goal
New Product

- Changing the product could make it easier to use robots on the construction site.
- For this you have to think about the possibilities and limitations of the robot.

Curtain Wall and Robot

Possibilities Curtain Wall and Robot

- Robot
- Curtain Wall
- Robot + Curtain Wall
- or
- Robot + Curtain Wall
Curtain Wall and Robot

The added value of integration compared to other options is that the robot is one with the Curtain Wall

The advantages:
- Easy adoption to the demands of the user, the curtain wall panel will be easy to replace
- The non performing parts will be easy to replace

When the robot is not necessary for the assembling or disassembling of the curtain wall panels. The robot can be used for other functions, such as user functions

For example
- Window-cleaner installation
- Sunblind
- Visual radiation
Curtain Wall and Robot

Examples user functions

Window-cleaner installation

sunblind

Introduction – Assembling Curtain Wall Panels – Robotic Technologies – 
Robot and Curtain Wall – Integration – Goal

Curtain Wall and Robot

Active Wall
Curtain Wall and Robot

**Should it be possible??**

- Yes, at the moment actuators are made smaller and stronger
- Sensors become better and smaller

Integration

Integrate a Robot in a curtain wall and use robotic technology for the entire life cycle

<table>
<thead>
<tr>
<th>Life cycle of a Curtain wall with robotic technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>assembing</td>
</tr>
<tr>
<td>------------</td>
</tr>
<tr>
<td>Curtain Wall + Robotic Technology</td>
</tr>
</tbody>
</table>
Goal

Demands

• Assembling from the ground
• Assembling by a machine in or on the panel without direct human control.
• Panels should be easily replaceable during their life cycle, without having to disassemble the whole curtain wall.
• Using standard frame so there are more options for the visualization, user functions and so on.
• Fixed connecting points
• Standard size panels
• Using the robot for user functions or visualization during the curtain Wall life cycle. Creating a active wall.
• The panel should be easy to assemble able

So you get a Curtain Wall

A self assembling Wall
• You don't have to use the crane
• No working on dangerous places anymore

An easy adaptable wall.
• Adaptable to the user demands.
• Adaptable to technical and visual changes

Creating an Active Wall
• Adaptable to the surroundings, sun blind
• Self maintaining, window-cleaner installation
• Visual image
Goal

Integrate a Robot in a curtain wall and use robotic technology for the entire life cycle

Wall Panel
Self Assembling
Adaptable
Active Wall

Questions!