

Technology and Management for the Decommissioning of Nuclear Facilities

IAEA Workshop “Decommissioning Technologies” 6 - 10 July 2009 in Karlsruhe, Germany

Prof. Dr.-Ing. Sascha Gentes
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Agenda

1. Karlsruhe Institute of Technology (KIT)
 - 2.1 Institute for Technology and Management in Construction (TMB)
 - 2.2 Shared Professorship for Technology and Management for the Decommissioning of Nuclear Facilities
3. Shaving Technology
4. Cutting Technology
5. Summary

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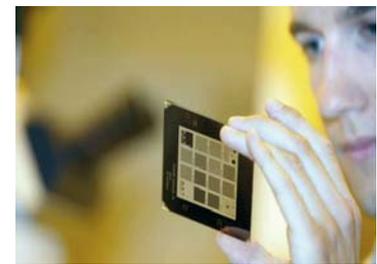
1. Karlsruhe Institute of Technology (KIT)



Lecture

Research

Innovation



1. Karlsruhe Institute of Technology (KIT)

2.1

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2.1 Institute for Technology and Management in Construction (TMB)

The TMB represents the major field of „Construction Management“ within the Department of Civil Engineering-, Geo- and Environmental Sciences at the Universität Karlsruhe (TH).

Facts and Figures

- approx. 20 students per year
- 35 employees, thereof
- 3 professors
- 22 research assistants
- 4 employees at the workshop



1.

2.1 Technology and Management in Construction (TMB)

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Workshop and Testing Facility



Front view



Workshop



Testing facility

1.

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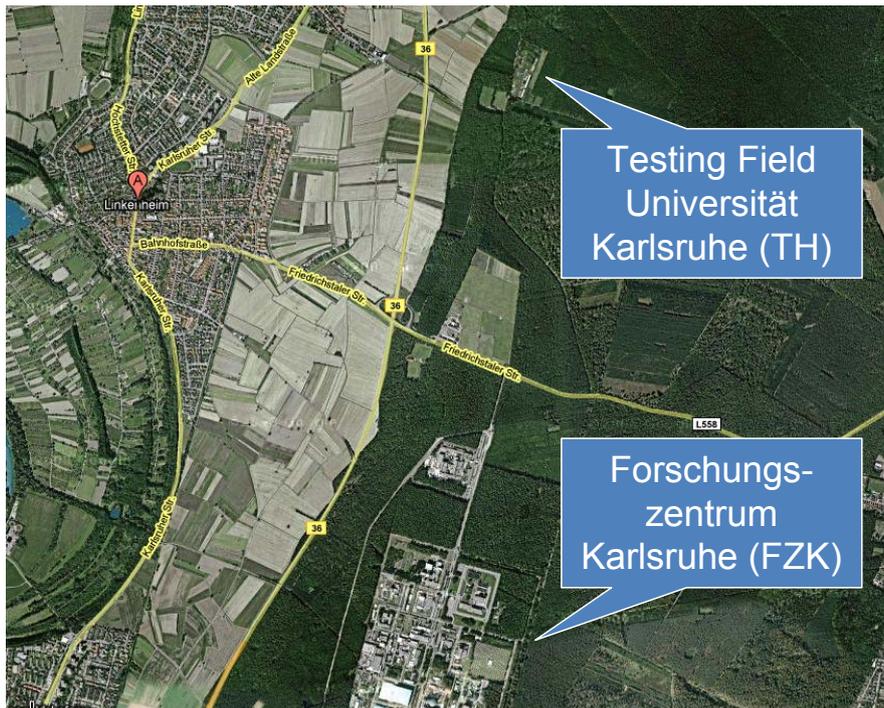
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Location of the Testing Field close to FZK



Testing Field
Universität
Karlsruhe (TH)

Forschungs-
zentrum
Karlsruhe (FZK)

1.

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Resources



- Underwater testing facility
- Mock-ups on a scale of 1 : 1

- Construction machinery
- Aggregates for concrete crushing



1.

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International Co-operations of TMB

- **Purdue University, USA**
Construction Engineering and Management
- **University of Tokyo, Japan**
Department of Civil Engineering
- **Uni Federal do Parana, Brasil**
Sector Technologia, Centro Politecnico
- **Universidade Federal da Bahia, Brasil**
Escola Politécnica
- **Technical University of Cluj, Romania**
Faculty of Civil Engineering
- **Indian Institute of Technology Madras, India**
Building Technology & Construction Management



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Our Main Targets in Research and Consulting

The main targets in research and consulting of the Institute for Technology and Management in Construction are:

- Construction Process Engineering and Site Management
- Construction Equipment
- Construction Management
- Facility Management
- Lean Management
- Hazard Management



Since 1992 research is being conducted in the area of „Decommissioning and Deconstructing Reinforced Concrete Structures at Nuclear Power Plants“.

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2.1 Technology and Management in Construction (TMB)

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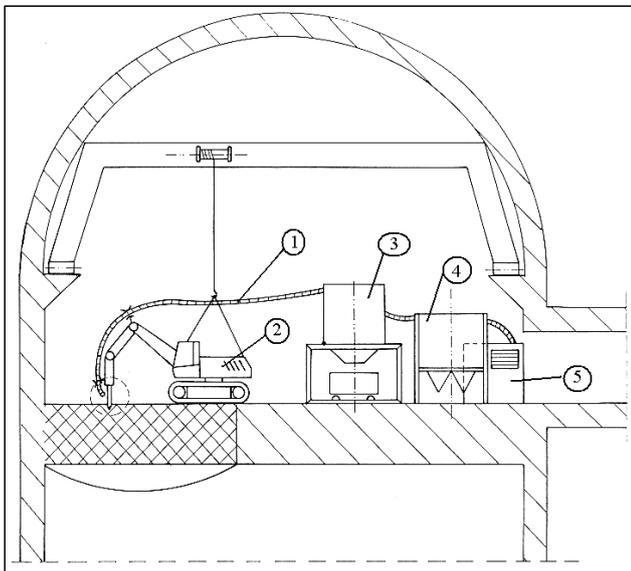
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Sample Projects:

Demolition of a heavy concrete slab ($\rho = 4,200 \text{ kg/m}^3$) with a thickness of approx. 2 m at the Compact Sodium-cooled Nuclear Reactor (KNK) at Forschungszentrum Karlsruhe.



1. Conveyance tube
2. Excavator for decommission works
3. Separator for coarse materials
4. Micro filter
5. Suction unit with sound absorber

1.

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Sample Projects:

Mock-up and test run at the testing facility of TMB



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Sample Projects:

Operation of the tested equipment at the KNK



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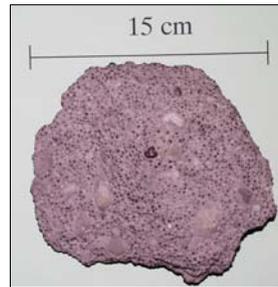
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Sample Projects:

Filtration system and its separation efficiency



Separator for coarse materials from 150 mm to 0,2 mm



Microfilter

1.

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Sample Projects:

Waterless diamond wire saw technology



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Sample Projects:

Tests for the milling of reinforced concrete walls inside of a sluice



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2.2 The Shared Professorship of Technology and Mgmt. for the Decommissioning of Nuclear Facilities

**New Professorship at the Karlsruhe
Institute of Technology since 2008**

- Announced within the scope of the future concept „KIT“
- Alternating activities at the KIT and the main sponsor's company
- Sat. Kerntechnik GmbH (main sponsor)
- Other partners



KERntechnik GmbH

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2.2 Decommissioning of Nuclear Facilities

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Fields of Activity within the Shared Professorship

- Setup of a scientific and technical team of excellence for the decommissioning of nuclear facilities at KIT
- Development of new practical decommissioning technologies
- Setup of a graduate course for „Operation, Demobilisation and Decommissioning of Nuclear Facilities“

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2.2 Decommissioning of Nuclear Facilities

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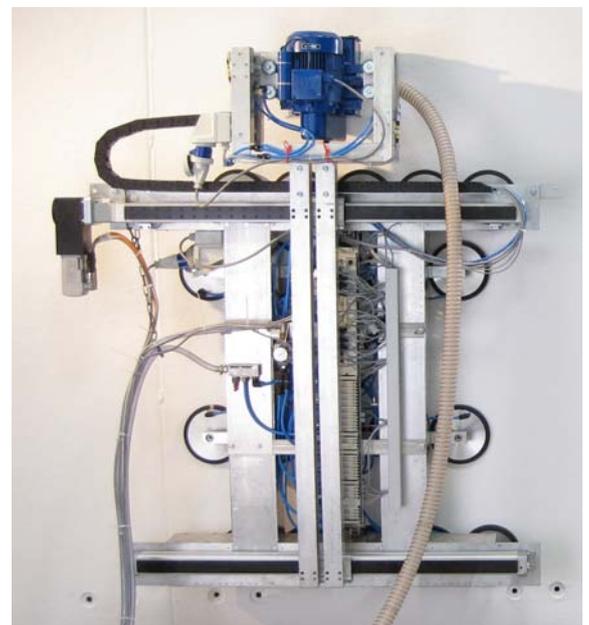
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3. Shaving Technology

Autonomous **MAN**ipulator for **De**contamination **AS**signments (**AMANDA**)



- Equipped with a milling attachment for decontamination purposes
- Can be operated on walls and ceilings
- Vacuum technology provides the connection between the manipulator and the object to be treated
- Requires 1 operator



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Basic Tests: Surface Abrasion and Tools

- Milling disc (n)  Roughness
- Feed (v)  Precision
- Downforce (F)  Manipulator
- Milling power (P)  Operating efficiency



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Parameters of the 20 Testing Series

Milling depth	Feeding speed	Milling discs
1 mm 3 mm	1 m / min 2 m / min	disc 1 disc 2 disc 3 disc 4 disc 5



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Surface Textures (Roughness of the Surface R_a)

Disc 1



Disc 2



Disc 3



1.

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Vacuum Suction Plates Experiments

Determination of the maximum suction power of suction plates with diameters of 160 mm and 200 mm



$F_{horizontal, max}$



$F_{vertical, max}$

$$F_{H,max} \text{ and } F_{V,max} = f(\text{disc, milling depth, roughness } R_a)$$

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3. Shaving Technology

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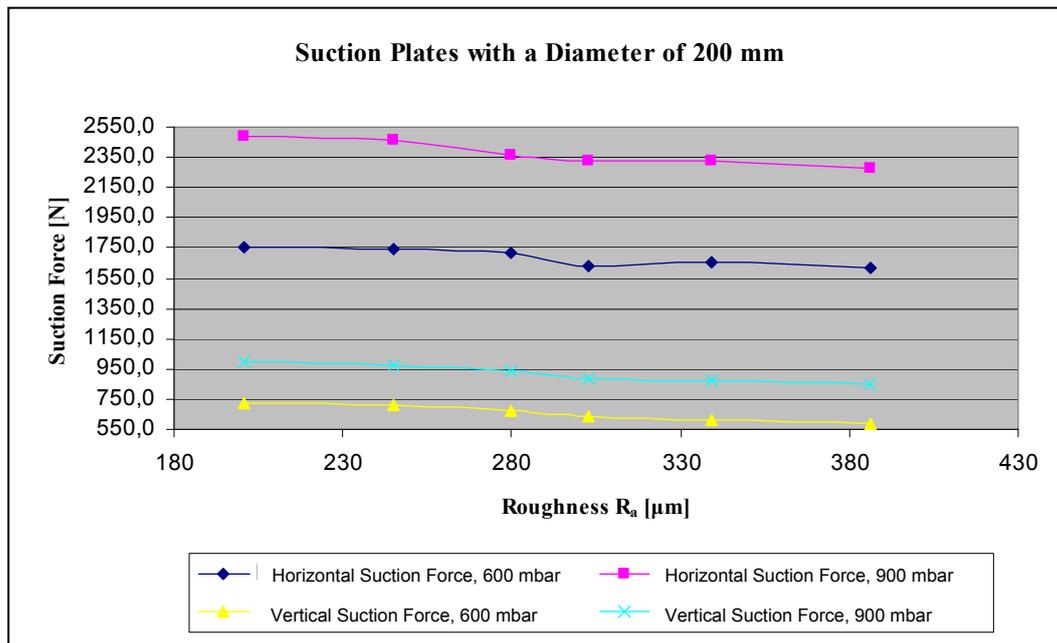
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Interdependence of the maximum Suction Force and the Roughness of the Surface R_a



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3. Shaving Technology

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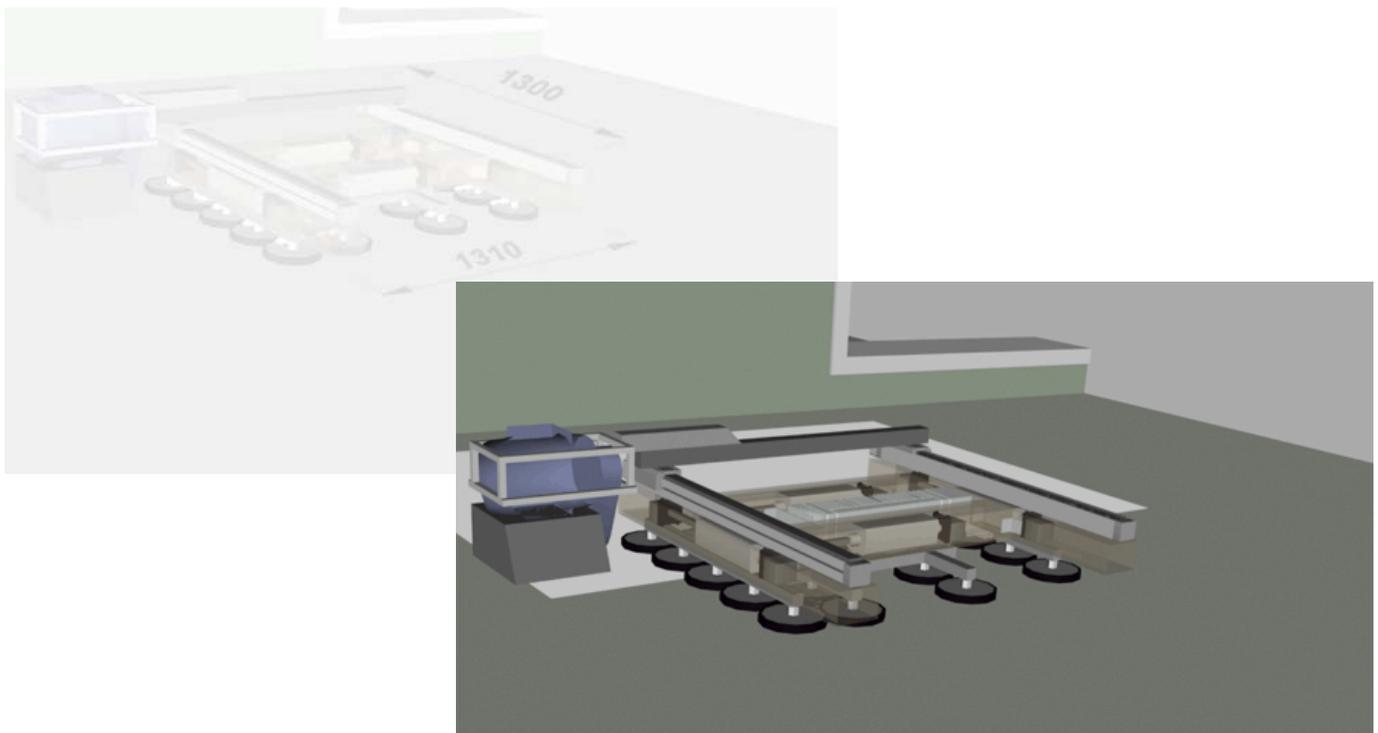
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AMANDA Simulation Studies



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Easy and Flexible Assembly

0 kg

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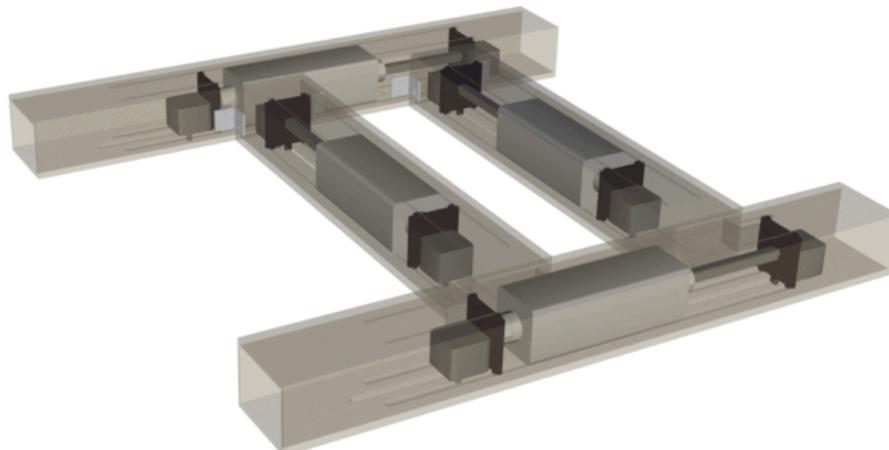
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Easy und Flexible Assembly

96 kg



1.

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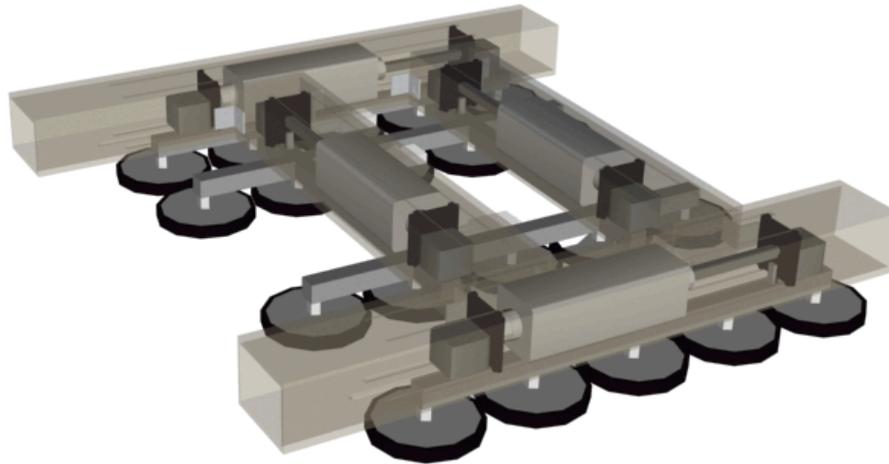
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Easy and Flexible Assembly

159 kg



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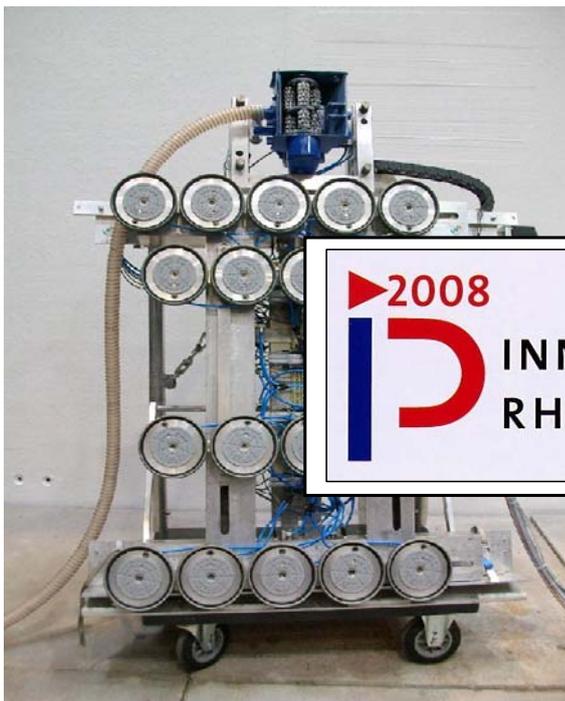
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Current Status of Development



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3. Shaving Technology

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Technical Details

- Energy supply: compressed air (max. 6 bar, 1,200 l/min), electricity
- Performance: 4 m²/h (at a milling depth of approx. 3 to 4 mm)
- Personnel: 1 operator
- Wastage: suction plates (robust, easy to change)
milling discs (minimized waste)

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3. Shaving Technology

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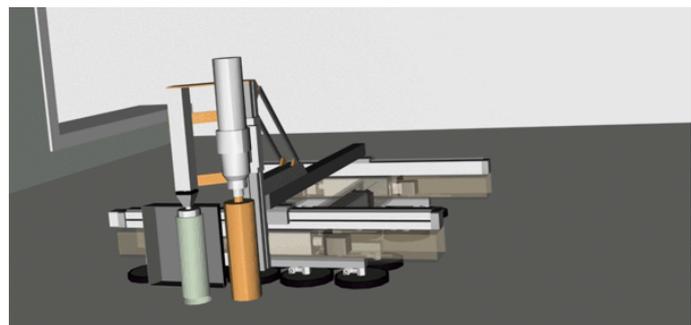
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Improvement of other Attachments



Concrete of Mock-Up:

- reinforcement 200 kg/m³
- quality of concrete C30/37

1.

2.1

2.2

3. Shaving Technology

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Greater Objective of the Basic System AMANDA



Autonomous recording of the surface contamination through a combined system of the manipulator and a measurement device



Subsequently, autonomous milling of the surface, specific to the needs, through a combined system of the manipulator and a laser.

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3. Shaving Technology

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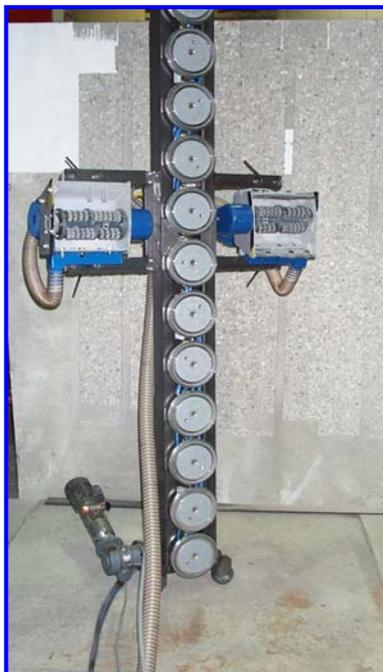
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Customized Adjustments and Improvements



AMANDA II

Two operators
For fix ceiling heights
With rollers

Two mills with extraction
For room heights up to 4 m
Autom. milling process

One operator
Independent from heights
With trolley



AMANDA III

1.

2.1

2.2

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Outlook

Automated Wire Saw Technology for Underwater Disassembly (ASTU)

- Three-year research project, financed by the Federal Ministry of Education and Research (BMBF), reference key # 02S8608
- Recording and modelling of all cutting parameters for any geometries available
- Practical related research in co-operation and with the support of Siempelkamp Nukleartechnik GmbH and Hilti Corporation / Liechtenstein

1.

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3.

4. Cutting Technology

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5. Summary

Current Co-operation partners:

sat. Kerntechnik GmbH
Wiederaufarbeitungsanlage Karlsruhe (WAK)
EnBW Kernkraft GmbH
Herrenknecht AG
Siempelkamp Nukleartechnik GmbH
Hilti Corporation
TU Dresden

Future Co-operation partners:

... IAEA ?

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Thank you for your attention.



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