Civil engineering contribution to long-term disaster risk mitigation

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The year 2017 was marked by numerous natural disasters, including hurricanes and fires, to which were added the cyclone Debbie in Australia and the earthquakes in Mexico.

The costs of covering the damage from natural disasters have peaked in 2017, according to a study by the Swiss reinsurer Swiss Re.

... 2016 may well be known as the year of the earthquake, as areas around the world trembled from seismic activity.
Civil engineering toward safe built environment

Basic Definitions / Common Project Glossary

- **Hazard** (natural and technogenic events)
- **Disaster** (functions disruptions)
- **Risk** (negative consequences)
- **Vulnerability** (inability to withstand the effects)
- **Resilience** (ability to spring back into shape)

Guide for DRM Systems Analysis
Definitions from ISDR Terminology version 2007
(www.unisdr.org/terminology)

HAZARDS

<table>
<thead>
<tr>
<th>Natural</th>
<th>Technogenic / man-made</th>
</tr>
</thead>
<tbody>
<tr>
<td>❑ Geological;</td>
<td>❑ Technological;</td>
</tr>
<tr>
<td>❑ Hydrological;</td>
<td>❑ Industrial;</td>
</tr>
<tr>
<td>❑ Meteorological;</td>
<td>❑ Security related (terrorism).</td>
</tr>
<tr>
<td>❑ Biological.</td>
<td></td>
</tr>
</tbody>
</table>

Defining by Characteristics

1. Length of forewarning
2. Magnitude of impact
3. Geographical scope of impact
4. Duration of impact
5. Speed of onset
### Natural disasters in Bulgaria

#### GEOLOGICAL PROCESSES AND PHENOMENA

<table>
<thead>
<tr>
<th>N</th>
<th>DISASTERS</th>
<th>AREA AFFECTED</th>
<th>MAJOR CRITERIA</th>
<th>CONSEQUENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EARTHQUAKES</td>
<td>regional*</td>
<td>Intensity – up to 12 degrees (MSK)</td>
<td>Soil displacements, cracks, land slides, fires, damage and collapse, human losses, ecological catastrophes</td>
</tr>
<tr>
<td>2</td>
<td>SLOPE FAILURES (landslides, landslips, creep, falls, flows, subsidence)</td>
<td>local**</td>
<td>Mass and velocity flow</td>
<td>Rock mass, material loss, human losses</td>
</tr>
<tr>
<td>3</td>
<td>MUD-ROCK FLOWS</td>
<td>local</td>
<td>Mass, velocity flow</td>
<td>Mud- stone flow, material loss, human losses</td>
</tr>
<tr>
<td>4</td>
<td>EROSION AND ABRASION</td>
<td>local</td>
<td>Process intensity and speed</td>
<td>Dislocations, collapses, material loss, human losses</td>
</tr>
<tr>
<td>5</td>
<td>STORM SURGE</td>
<td>local</td>
<td>hurricane winds</td>
<td>Dislocations, collapses, material loss, human losses</td>
</tr>
<tr>
<td>6</td>
<td>TSUNAMI</td>
<td>local</td>
<td>sea floor displacement or triggering of slumps</td>
<td>Dislocations, collapses, material loss, human losses</td>
</tr>
</tbody>
</table>

#### HYDROLOGICAL AND METEOROLOGICAL PROCESSES AND PHENOMENA

<table>
<thead>
<tr>
<th>N</th>
<th>DISASTERS</th>
<th>AREA AFFECTED</th>
<th>MAJOR CRITERIA</th>
<th>CONSEQUENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>FLOODS</td>
<td>regional, local</td>
<td>Racing the river level</td>
<td>Flooding of riparian zones, material loss, human losses</td>
</tr>
<tr>
<td>8</td>
<td>SNOW FLOWS AND GLACIATIONS</td>
<td>regional, local</td>
<td>Quality of snow falls over 20 mm in 12 hours</td>
<td>Snowdrift - difficulties for road infrastructure</td>
</tr>
<tr>
<td>9</td>
<td>DROUGHT</td>
<td>regional, local</td>
<td>High temperatures and low humidity</td>
<td>Damage in agriculture, reducing soil fertility, fire</td>
</tr>
<tr>
<td>10</td>
<td>TEMPERATURE EXTREME</td>
<td>regional, local</td>
<td>Temperature</td>
<td>material loss, human losses</td>
</tr>
<tr>
<td>11</td>
<td>THUNDERSTORM</td>
<td>local</td>
<td>intensity</td>
<td>material loss, human losses</td>
</tr>
<tr>
<td>12</td>
<td>TORNADO PHENOMENA</td>
<td>local</td>
<td>Speed &gt; 30m/s</td>
<td>material loss</td>
</tr>
<tr>
<td>13</td>
<td>DUST STORMS</td>
<td>regional, local</td>
<td>High temperatures and low humidity, dusting</td>
<td>Damage in agriculture, reducing soil fertility, fire</td>
</tr>
<tr>
<td>14</td>
<td>HAILSTORMS</td>
<td>local</td>
<td>Icy grain size, intensity</td>
<td>Damage in agriculture</td>
</tr>
<tr>
<td>15</td>
<td>WET SNOW</td>
<td>local</td>
<td>Quantity and moisture content of snow</td>
<td>Damage to forests, orchards, electricity supply network</td>
</tr>
<tr>
<td>16</td>
<td>FOG (COASTAL, EVAPORATION, RADIATION, VALLEY, UPSLOPE)</td>
<td>regional, local</td>
<td>Horizontal visibility at distances less than 500 m</td>
<td>Transport, clean air</td>
</tr>
<tr>
<td>17</td>
<td>SILVER THAW</td>
<td>local</td>
<td>intensity</td>
<td>transport, agriculture</td>
</tr>
<tr>
<td>18</td>
<td>WILD LAND FIRE</td>
<td>regional, local</td>
<td>Temperature</td>
<td>Thermal effects, material losses, damage to the biosphere and soil</td>
</tr>
<tr>
<td>19</td>
<td>STRONG WIND</td>
<td>regional, local</td>
<td>Speed &gt; 15m/s</td>
<td>material loss</td>
</tr>
</tbody>
</table>
Civil engineering toward safe and sustainable built environment and infrastructure

MAJOR ROLE OF THE CIVIL ENGINEERS PLAY A IN THE DISASTER MITIGATION:

- to create safe and sustainable built environment
- to coordinate the integrated efforts of all those involved in the construction process.

The Built Environment Professions in Disaster Risk Reduction and Response
A guide for humanitarian agencies

Published by MLC Press, University of Westminster, 2009
© Max Lock Centre, University of Westminster 2009
ISBN 978-1-905832-04-6

The built environment professions are included in two main categories of professionals:

1. Engineering professionals
2. Architects, planners, surveyors and designers.

International Labour Organisation’s International Standard Classification of Occupations, ISCO-08 →
safe and sustainable built environment and infrastructure

RISK MANAGEMENT

Preparedness

Prediction and early warning

Disaster

Mitigation and prevention

PROTECTION

Recovery

Response

Impact assessment

Reconstruction

RECOVERY

Smart Input ↔ Controlled Output
Civil engineering toward safe and sustainable built environment and infrastructure

Figure 1: The disaster risk management and response spiral

Pre-disaster risk Reduction phase

Disaster prevention and sustainable development

Disaster preparedness

Impact

Relief

Early recovery/transition

Post-disaster recovery

Risk reduction

Risk and vulnerability assessment

Development and ongoing risk reduction

Reconstruction

Time

Pre-disaster phase

Post-disaster phase

Emergency

Catastrophe

Crisis

Disaster

Kouteva, Boshnakov
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MAJOR ROLE OF THE CIVIL ENGINEERS PLAY A IN THE DISASTER MITIGATION:

- to create safe and sustainable built environment
- to coordinate the integrated efforts of all those involved in the construction process.

- Applied civil engineering science
- Civil engineering practice
- Civil engineering education
Safe and sustainable built environment

- Applied civil engineering science
  - Hazard identification, analysis and estimation
    - Mapping hazards (characteristic parameters)
  - Vulnerability definition, analysis and estimation
    - Advanced structural modelling – numerical and experimental
  - Risk identification and estimation
    - Proper land use and city planning
    - Design and building code development
  - Early warning - monitoring and instrumentation
    - Data collection, processing – storage, access, dissemination
  - Disaster management
  - Disaster risk management
  - Integrated vulnerability and risk estimation
Safe and sustainable built environment

- Civil engineering practice

- Express expert damage classification
- Early recovery and emergency strengthening
- Temporary housing
- Recovery of the built environment
- Monitoring and instrumentation
- Data collection, processing – storage, access, dissemination
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- Policy maker
- Planner
- Structural engineer
- Geotechnical engineer
- Hydrological / irrigation engineer
- Environmental engineer / Public Health /
- Sanitary engineer
- Surveyor
- Transportation engineer
- Marine engineer
- Services consultant (Plumbing, Fire-fighting,
  Lift, HVAC, Electrical)

- Construction manager
- Project manager
- Site supervisor
- Site engineer
- Builder / Contractor
- Research and development; academics
- User of constructed facilities
- ................. many more
Safe and sustainable built environment

- Civil engineering education

- Public education – public awareness
- Kinder garden, primary school, secondary and high schools,
- University undergraduate education
- Postgraduate education – qualification courses, MSc, PhD, advanced studies
- Post graduate education
- Training courses, public, research and other forums,
- Internet & social media information
- … … integrated multi-disciplinary advanced research … … …
Safe and sustainable built environment

- Education towards Disaster Risk Mitigation in Bulgaria

Education related to Protection of the Population from Disasters, Accidents and Catastrophes is introduced at different Bch and MSc programmes at the different Bulgarian Universities – national military universities and civil universities – most courses are related to the RESPONSE PHASE OF THE DISASTER MANAGEMENT CYCLE.

- Civil engineering education towards Disaster Risk Mitigation – new MSc Program at UACEG - University of Architecture, Civil Engineering and Geodesy, Bulgaria

ENGINEERING PROVISION OF PROTECTION AGAINST DISASTERS AND ACCIDENTS

(EPPADAA)

MSc, UACEG
Safe and sustainable built environment

- Civil engineering education towards Disaster Risk Mitigation – EPPADA – UACEG – Faculty of Structural Engineering

EPPADA Objective:

To prepare specialists - experts and consultants for engineering protection against disasters and accidents.

This MSc program is planned to be a prerequisite for:
- personal development,
- active citizenship,
- communication between the various institutions responsible for disaster and accident risk management and reduction of their negative consequences in modern society.
Safe and sustainable built environment

- Civil engineering education towards Disaster Risk Mitigation – EPPADA – UACEG – Faculty of Structural Engineering

**Major EPPADA issues / disciplines:**

- methods for disasters and accidents risk assessment;
- civilian safety - security and criminal - terrorist activity in the field of construction;
- legal and economic aspects of the protection against disasters and accidents;
- uniform integrated security and disaster protection system;
- international and national strategies for disaster protection;
- preventive measures to reduce damage from disasters and emergencies;
- application of information technologies for organization and protection of the population from natural disasters and accidents;
- crisis and accident management approaches, communication procedures for interaction among civil and military institutions;
- sustainable development policies and smart cities through the prevention of crises related to disasters and accidents.

ENGINEERING PROVISION OF PROTECTION AGAINST DISASTERS AND ACCIDENTS
MSc, UACEG
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Upon completion the full course of training, the Master of Engineering Assurance for Disaster and Accident Protection can perform various activities and assume appropriate responsibilities as an expert / consultant / supervisor of:

- state administration and local government structures and specific establishments and/or special organizations for population and infrastructure protection;
- risk management of disasters and accidents in the interest of state institutions and non-governmental organizations;
- specialized units for monitoring of buildings and facilities, storage and processing of data;
- Scientific and research work;
- Other positions requiring knowledge and qualification in the field.
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Admission of students

The students enrolled in this MSc program shall possess certificate of prior completion of full course of education in any of the specialties in the professional track 5.7 „Architecture, construction and geodesy“, in the field of „Technical sciences“, and possess the educational degree of „Master“ or „Bachelor“ of sciences. The criteria for student admission are based on the assessment results in specific disciplines gained during the course of their prior education. In cases where applicants possess scientific degrees in other professional tracks they will be advised to attend an additional preliminary semester for acquisition of the necessary common and specific knowledge in the field of construction.
CONCLUSIVE REMARKS

The process of this program preparation itself proved to the program development team and to the authors the need for extending the narrow limits of construction specialists education to accommodate the interdisciplinary knowledge required for effective participation in accidents and disaster prevention.
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THANK YOU FOR YOUR KIND ATTENTION

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