RESEARCH IN ANALYSIS AND CONSERVATION OF ARCHITECTURAL HERITAGE

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ANALYSIS AND CONSERVATION OF STRUCTURES OF ARCHITECTURAL HERITAGE AS SCIENTIFIC FIELD

- ICOMOS / ISCARSAH COMMITTEE (RECOMMENDATIONS)
  OTHER COMMITTEES: ISO TC 98 (ISO 13822, ANNEX I)


- INTERNATIONAL JOURNAL OF ARCHITECTURAL HERITAGE

- COLLABORATIVE RESEARCH PROJECTS (NIKER)

- MASTER SAHC

- PH. STUDIES
EXAMPLES OF RESEARCH AREAS

- GENERAL METHODOLOGY FOR ANALYSIS AND CONSERVATION
- CONSERVATION OF MATERIALS
- COMPUTATIONAL METHODS FOR STRUCTURAL ANALYSIS
- TECHNOLOGIES FOR INSPECTION (NDT, MDT) AND MONITORING
- LABORATORY EXPERIMENTAL TECHNIQUES.
  CHARACTERIZATION OF TIMBER, MASONRY AND EARTH
- REPAIR AND STRENGTHENING TECHNIQUES
- SEISMIC PROTECTION
NEED FOR FURTHER RESEARCH

- Need for more realistic and also efficient computer methods
- Experimental information still insufficient. Additional experimental evidence needed for calibrating and validating analytical and numerical tools
- Need for more powerful and efficient (while affordable) monitoring technologies
- Better integration of different methods and approaches (numerical simulation & inspection, monitoring)
- Need for efficient and compatible repair and strengthening techniques
- Need for strategies for protection and repair against natural disasters
SOME “HOT” TOPICS FOR RESEARCH

- ADVANCED NUMERICAL TECHNIQUES FOR MASONRY STRUCTURES
- SEISMIC ANALYSIS ADVANCED METHODS
- STRATEGIES FOR SEISMIC PROTECTION
- LONG-TERM DEFORMATION, DAMAGE AND COLLAPSE
- COMPATIBLE STRENGTHENING SOLUTIONS
  USE OF COMPOSITES / INJECTION …
- APPLICATION TO COMPLEX CASE STUDIES
Some examples of research topics

Seismic analysis of large historical structures by integrating structural modelling and monitoring. Model updating and validation approaches

Simulation of masonry strength and deformation by means of detailed micromodels

Damage in buildings due to subsidence induced by tunnelling

Modelling of the dynamic and seismic response of skeletal masonry buildings. Application to nonlinear dynamic analysis in the time domain

Simplified models for the assessment of masonry shear walls (solid and with openings)

Analysis of buckling failure of masonry walls
Research focuses

<table>
<thead>
<tr>
<th>EXPERIMENTAL</th>
<th>MODELING AND COMPUTER SIMULATION</th>
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- **CRITERIA AND GUIDELINES FOR DESIGN OR ASSESSMENT**

- **APPLICATION TO REAL STRUCTURES**

- **Graph**: Data points for different reinforcement areas ($70, 80, 90, 100, 110, 120, 130, 140, 150$) and capacities ($70, 90, 110, 130, 150$). The graph shows reinforcement area in $[mm^2]$ on the x-axis and capacity in $[KN]$ on the y-axis.

- **Legend**: Point styles include $f_c = 4MPa$, $f_c = 5MPa$, $f_c = 6MPa$, and $f_c = 7MPa$.
EXPERIMENTS AT REAL SCALE

EXPERIMENTS ON SCALE STRUCTURES

MODELLING AND PARAMETRICAL STUDIES

Validation

EXPERIMENTS AT REAL SCALE

EXPERIMENTS ON SCALE STRUCTURES

MODELLING AND PARAMETRICAL STUDIES

Validation

Broadening the amount of reference results

DESIGN CRITERIA OR GUIDELINES
SIMPLIFIED METHODS

APPLICATION TO REAL STRUCTURES

Validation

Example of methodological approach
EXPERIMENTS

COMPONENT MATERIAL

ELEMENTARY ASSEMBLAGE

COMPLEX MEMBER

FULL SCALE

SCALE

FULL STRUCTURE

FULL STRUCTURE

SCALE
EXPERIMENTS

COMPONENT MATERIAL

ELEMENTARY ASSEMBLAGE

COMPLEX MEMBER

FULL SCALE

SCALE

FULL STRUCTURE

FULL STRUCTURE SCALE
EXPERIMENTS

COMPONENT MATERIAL

ELEMENTARY ASSEMBLAGE

COMPLEX MEMBER

FULL SCALE

SCALE

FULL STRUCTURE

FULL STRUCTURE

SCALE
NUMERICAL METHODS

MICROMODELLING

MACROMODELLING

HOMOGENIZATION

SIMPLIFIED METHODS

SHEAR WALLS

BUILDINGS

STRENGTHENED MASONRY ARCHES
NUMERICAL METHODS

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FINAL REMARKS

• SPECIALIZED RESEARCH IS STILL NEEDED IN THE CONTEXT OF ANALYSIS AND CONSERVATION OF HERITAGE STRUCTURES

• NEED FOR MORE EXPERIMENTAL EVIDENCE, NEED FOR ADVANCED COMPUTER METHODS, NEED FOR ADEQUATE NDT AND MONITORING TECHNOLOGIES

• GROWING NUMBER OF RESEARCHERS INVOLVED

• YOUR CONTRIBUTION IS WELCOME