

Evaluation Panel: ENGINEERING SCIENCES AND TECHNOLOGIES - Civil and Geological Engineering

Panel Members

Lyesse Laloui (Chair)	École Polytechnique Fédérale de Lausanne (EPFL), Switzerland
Vladimir Nikora	University of Aberdeen, United Kingdom
Farrokh Nadim	Norwegian Geotechnical Institute, Norway
Bernardino Chiaia	Politecnico di Torino, Italy
Mario Di Paola	University of Palermo, Italy

R&D Units

Centro de Materiais e Tecnologias Construtivas (C-MADE)	Universidade da Beira Interior (UBI)
Centro de Território, Ambiente e Construção (CTAC)	Universidade do Minho (UM)
Instituto de I&D em Estruturas e Construções (CONSTRUCT)	Faculdade de Engenharia da Universidade do Porto (FE/UP)
Instituto de Investigação e Inovação em Engenharia Civil para a Sustentabilidade (CERIS)	Associação do Instituto Superior Técnico para a Investigação e o Desenvolvimento (IST-ID)
Instituto para a Sustentabilidade e Inovação em Estruturas de Engenharia (ISISE)	Universidade do Minho (UM)
Riscos e Sustentabilidade na Construção (RISCO)	Universidade de Aveiro (UA)

Evaluation Panel: ENGINEERING SCIENCES AND TECHNOLOGIES - Civil and Geological Engineering

R&D Unit: Centro de Materiais e Tecnologias Construtivas (C-MADE)

Coordinator: Jorge Tiago Queirós da Silva Pinto

Integrated PhD Researchers: 14

Overall Quality Grade: WEAK

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 2
- (B) Merit of the team of Integrated Researchers: 3
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 2

Justification, Comments and Recommendations

The Centre of Materials and Building Technologies (CMADE) at the University of Beira Interior is a R&D Unit in Civil Engineering field and related areas, formed by a consortium between the University of Beira Interior (UBI) and the University of Trás-os-Montes e Alto Douro (UTAD). The scientific objectives of CMADE can be divided into five main strategic fields as follows:

1. Sustainable materials and binders for building and road infrastructures;
2. Mechanical behavior and durability, addressing topics such as the structural safety and durability of buildings systems and infrastructures;
3. Energy efficiency and environment, focusing on smarter use of energy by improving the energy efficiency of buildings and reducing the emission of greenhouse gases;
4. Resource efficiency and raw materials, addressing sustainable and efficient use of resources, mitigation of human environmental impacts and adaptation to global changes.
5. Territorial analysis and building design, to promote a harmonious economic, social and spatial development.

The 5 contributions that the R&D Unit CMADE considers most important of those provided in period 2013-2017 are the following:

1. Study and proposal of several innovative ideas based in recycling mining wastes and industrial wastes.
2. Study of the interdependent relationship between consumptions of water and energy have been studied in order to contribute for a more sustainable use of these resources.
3. Study of different technical solutions with the objective of reducing urban flood such as green roofs and permeable pavements.
4. Study of an indirect gain passive solar system: the Trombe wall.
5. A research work has been performed concerning tabique buildings.

Among the above contributions, most relevant are two research areas, namely the innovative ideas for recycling mining and industrial wastes and the development of different technical solutions for reducing urban flood such as green roofs and permeable asphalt pavements (PAP). These research themes appear very interesting and of a potential impact. The scientific quality of these two areas of research can be considered good. The scientific relevance and impact of the three other contributions is considered less important in terms of originality, consistency and rigor of results according to international standards and level of journal scientific publications.

The overall judgement on publications, advanced training (PhD and PostDoc level) and initiation of undergraduate or Master students to research, dissemination and outreach of R&D results and data with promotion of scientific and technological culture, technology transfer (patents, prototypes or products, spin-offs), social/economic relevance to society of the CMADE activity is sufficient. Certainly, the Unit suffers because of its small size which prevents more ambitious goals and scientific results on larger scales. In spite of this a so small size, the Director of UBI is coordinator of RIMED project at European level.

In conclusion, no specific case or situation of resources or competencies of exceptional quality or value can be detected. International partnerships are of good level. The initiatives aiming at attracting resources for R&D activities from private sources (industry) have not been that successful. Finally, the research approaches and methodologies deserve to be addressed by more fundamental and up-to-date considerations.

The faculty members of CMADE are currently involved in a few masters and doctoral programmes. At the end of the period the number of Integrated Researchers was equal to 17 (all holding a PhD). The CMADE R&D Unit is organized in a single research group including all members from both UBI and UTAD.

Funded resources to CMADE have been equal to 362 KEuro in the considered 5 years. Funding by FCT was proportionally relevant and represents the largest contribution (270 KEuro). In particular, the Unit Pluriannual funds in the period were equal to 112 KEuro. Funding by the European Commission was equal to 92 KEuro. Quite surprisingly, funding by private companies in Portugal and abroad was null, which appears strange considering the potential practical applications of the research efforts.

The global scientific and technical merit of the team of Integrated Researchers of CMADE can be considered of average level. There is evidence of a standard national recognition and of increasing international development.

The nature of the R&D activities of CMADE could have strong impact in society. The R&D activities in the period 2013-2017 may be considered good taking into account the size of the Unit. Research team competencies of good quality maybe detected up to now.

Description of the objectives and strategy of the CMADE R&D Unit, provided in the proposal for 2018-2022 appears too general. The strategic objectives are oriented towards a vision coupling innovation, industry interface, and people in general, respectively:

- being known for its scientific and professional activity and as an international leader in specific areas, through the capacity of providing a singular contribution to societal challenges and to the solution of complex problems at a global scale, while addressing local, regional and national issues;
- being known as a "R&I cluster" for developing outstanding Research & Innovation (R&I) that creates value for its customers, thus contributing to increase industry competitiveness, including SME's;
- being known as an attractive R&I Unit to work with, offering conditions for motivated people to improve their abilities and to produce knowledge that enables technical and social development.

Most of CMADE research production is laboratory based and the R&D Unit is very committed to develop existing laboratories. Taking into account the distinct approaches and scales of the partners resources, and the multidisciplinary nature of the infrastructure, CMADE claims that it will be possible to develop and test innovative solutions from conception to application.

In terms of sustainable materials and binders, the main goal will be to address some of the aspects related to development and implementation environmentally friendly binding materials for concrete and asphalt applications. Aspects related to the use of recycled materials or eco-materials with low-incorporated energy, will be strategic to reduce the impacts of the construction industry on the environment.

In terms of mechanical behavior and durability, the goals of CMADE consist on addressing topics such as the structural safety and durability of buildings systems and infrastructures and the implementation of smart warning systems. A special emphasis will also be put to the rehabilitation of existing constructions and the durability of civil engineering materials.

The energy efficiency and environment study will be focused on smarter use of energy by improving the energy efficiency of buildings, by developing more energy-efficient technologies and solutions that contribute to the global efforts to mitigate climate change and reduce CO2 emissions.

Finally, concerning resource efficiency and raw materials the objectives of CMADE are to address sustainable and efficient use of resources, mitigation of human environmental impacts and adaptation to global changes.

The CMADE plans for improving its internationalization, its overseas recognition, its advanced training in the period 2018-2022 are described quite generally, without putting into evidence specific actions and strategies. On the other hand, ethical issues are adequately addressed and an acceptable governance model for the unique research group of the Unit is envisaged.

The expected funding by FCT is equal to 50 KEuro, corresponding to 40% of the entire budget of the CMADE for the 5-years period (124 KEuro). The proposed budget includes almost 40% of the total for external researchers and mission. Moreover, the percentage of cost of service and products procurement and acquisition (40%) is not satisfactorily

described, and the other 40% of the expense budget item in the next 5-years period is devoted to service product procurement and acquisition and the remain are for “other expenses”.

In conclusion, the configuration and organization model of the R&D Unit should be suitable to its objectives and R&D activities. Much more efforts should be devoted to funding strategies, especially at the international (EU) and industrial level.

The PhD students will be more encouraged to publish papers in ISI Journals during their studies. During the last year some moderate teaching experience is necessary to develop skills for the future academic career.

Evaluation Panel: ENGINEERING SCIENCES AND TECHNOLOGIES - Civil and Geological Engineering

R&D Unit: Centro de Território, Ambiente e Construção (CTAC)

Coordinator: Paulo António Alves Pereira

Integrated PhD Researchers: 27

Overall Quality Grade: WEAK

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 2
- (B) Merit of the team of Integrated Researchers: 3
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 2

Justification, Comments and Recommendations

The CTAC research activities relate to two main interdisciplinary themes: "Sustainable Built Environment and Energy Efficiency" and "Sustainable and Resilient Systems and Infrastructures". The research work covers nine specific topics: (1) innovative and sustainable materials and products for construction; (2) innovative eco-construction and rehabilitation techniques; (3) energy efficiency in the built environment; (4) life-cycle modelling for nearly zero-carbon impact of buildings and infrastructures; (5) environmental friendly transportation systems; (6) sustainable and innovative materials and technologies for transport infrastructures; (7) flood and drought events forecasting and management; (8) drinking water safety planning; and (9) environmental quality assessment in cities and territories. To address these topics, the CTAC staff is integrated within five 'Research Areas of Competence': Ecomaterials; Sustainable Construction; Territorial Planning and Governance; Transport Systems and Infrastructures; Water Resources and Environment.

We evaluate this Unit in terms of quality, merit, relevance and internationalization as 'Weak'. Although the overall CTAC structure and research directions seem quite reasonable and well responding to the current challenges in civil engineering, the Panel notes that CTAC focus is dispersed across too many topics. Indeed, addressing nine topics by a group of 27 integrated PhD researchers suggests that there is some lack of the critical mass needed for achieving international or world-leading position in these topics. This is one of the reasons of insufficient international visibility and impact. Indeed, only a few Integrated PhD Researchers at Principal/Coordinator level have performed at national and international levels of quality and merit, while other researchers' work is of limited quality and merit in one or more areas of activity. There are also issues with objectives, strategy, plan of activities and organization. These factors may explain a fairly modest number of publications in top journals in respective areas, or at least some of them. Although the number of researchers in five 'Research Areas of Competence' are roughly the same across groups, their publications records are not homogeneous and vary quite substantially in terms of quantity and quality. The citations of published works are fairly modest. The rate of PhD project completion is not high and is well below than in internationally leading institutions. It was also found that there is no systematic programme for integration of PhD students under CTAC umbrella in the form of research seminars or other activities that would increase the cohesiveness of the group. The same applies to a small community of postdocs whose work is not integrated as well. As an example, the PhD students and postdocs could not recall when they had last seminar, who gave a talk, and what was the topic. That said, we do want to mention some visibility that the group has achieved, with few members serving on exec boards of leading international associations, several international projects, and involvements in the editorial boards of few journals ('Energy and Buildings', M. Almeida, 'Transportation Research', E. Freitas). However, the international visibility could be expected to be higher for an FCT-supported Unit, particularly in terms of keynote talks at major conferences, leading large networks and similar.

Five contributions identified in the application as most important relate to (1) revision of National Regulations regarding Energy Efficiency in Buildings; (2) GIS-based tool for assessing urban heat islands; (3) road infrastructure management system SustIMS; (4) advanced hydroinformatics platforms for improving preparedness and resilience to flood events; and (5) water safety planning implementation. The assessment of key performance indicators related to these contributions (journal papers, PhD dissertations) shows that they are at the national level, with very limited international impact. It should be mentioned, however, an international Global Road Achievement Awards (GRAA) – 2017 by the International Road Federation (IRF).

The team of CTAC Integrated PhD Researchers consists of senior members and researchers at an intermediate stage. Most international recognition and impact are brought by senior members while contributions of younger staff are fairly modest. The only example relates to Assistant Professor E. Freitas who serves on the Editorial Board of 'Transportation Research' (but the Panel had to search external sources to find it as no clear and specific information is given in application). Overall, it has to be said that international visibility of individual researchers is not high (e.g., no significant keynotes, international awards, or other recognitions) and is limited to very few.

The proposed objectives, overall strategy, and plan of activities for 2018-2022 represent a further development of the previous approach for the next five-year period. The applicants essentially propose to continue focusing on the same nine topics that have been followed in the preceding five years. The overall ambition for 2018-2022 is to be a major player in "Sustainable and Resilient Cities and Territories". The main activities are planned around four strategic directions: i) Scientific and technological research; ii) Advanced education and training; iii) Technology transfer, services and consulting; and iv) Dissemination of research results. The proposed actions in relation to internationalisation, advanced training (at PhD and Master levels), and knowledge and technology transfer continue the efforts of the preceding period. It is also noted that the CTAC intends to enhance activities in the areas of regulatory policies and governance, national and international collaborations, and participation in the key research and industry networks.

Justification for equipment is not specific and it is unclear how critical the proposed equipment is to support research developments in the forthcoming years. In relation to the requested new appointments of two researchers and one managerial assistant the situation is similar to that with equipment, e.g. the application states that "In order to support the strategic intervention of the Unit, mainly in relation to the launching of strategic research projects, CTAC needs the support of the following basic human resources: a) one management assistant; b) two junior researchers. The two junior researchers, under the coordination of the Unit Director, will have the job of preparing applications for the funding of multidisciplinary research projects, related to the two "main research fields of activity", as well as being responsible for the coordination of the execution of projects." From this description it is not clear what exactly the specific topics of these multidisciplinary projects are. The discussion during the site visit did not add much clarity, unfortunately. More importantly, little is done in terms of the critical assessment of the current situation, identification of the research teams of actual international significance within CTAC, assessing the staff movement/mobility (e.g., addressing forthcoming retirements), and selecting specific areas of strength where FCT funding could be directed for developing/maintaining critical mass and strengthening the international position of CTAC. The Panel impression is that the plans for 2018-2022 represent 'business as usual' rather than a strategy plan that would be based on proper self-critical assessment of the current situation.

The proposed organisational structure of CTAC is consistent with current standards in managing similar research establishments.

Reviewing two R&D Units (ISISE and CTAC) on the same day, the Panel noted a significant overlap in the research areas covered by these two Units. Specific examples include construction-related research and materials related work. But even water engineering area would fit well in a combined Unit as currently coastal defence related work is conducted within two Units. The Panel recommends that the applicants of both submissions (ISISE and CTAC) consider combining the strengths of both groupings in overlapping research areas in order to increase their efficiency, focus, and the overall cohesiveness and internal collaborations across topics.

Evaluation Panel: ENGINEERING SCIENCES AND TECHNOLOGIES - Civil and Geological Engineering

R&D Unit: Instituto de I&D em Estruturas e Construções (CONSTRUCT)

Coordinator: Álvaro Alberto de Matos Ferreira da Cunha

Integrated PhD Researchers: 51

Overall Quality Grade: GOOD

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 4
- (B) Merit of the team of Integrated Researchers: 3
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 3

Base Funding for (2020-2023): 582 K€

Recommended Programmatic Support

PhD Fellowships: 7

Programmatic Funding: 135 K€, including for 1 (Junior) New PhD Researchers Contracts.

Justification, Comments and Recommendations

The Institute of R&D in Structures and Construction (CONSTRUCT) at the Universidade do Porto is dedicated to the field of Civil Engineering, with a focus on Safety, Serviceability, Durability, Economy, Comfort and Sustainability of Civil Engineering constructions. CONSTRUCT selected, for its R&D activity, three main Focus Areas: sustainable construction, infrastructures and buildings. A total of 51 PhD holding integrated members are now belonging to CONSTRUCT.

In the period 2013-2017, 49 R&D projects were obtained under competitive calls at national or European level, 76 PhD Theses were concluded and 39 international conferences were organized by CONSTRUCT researchers.

The main contributions of CONSTRUCT in the period 2013-17, besides training high qualified technical and scientific leaders, are divided in 5 scientific advances: (1) Assessment of materials behavior boosting construction circularity; (2) Earthquake engineering, risk mitigation and preservation of cultural built heritage; (3) Advanced tools for dynamic testing and SHM of energy and transport infrastructures; (4) Advanced models for analysis of the train-infrastructure dynamic interaction; (5) Design for comfort, energy efficiency and moisture control of buildings adapted to the specificity of the south of Europe.

The most relevant results – to our opinion - can be evidenced in the two areas of earthquake engineering and risk mitigation and of rail transport infrastructures, where CONSTRUCT has gained a worldwide reputation both at the scientific level (with PhD training and top journal publications) and at the technology transfer level, with a great number of funded projects with impact on structural codes and innovation. The results in the other fields appear, however, of medium level.

The overall judgement on publications, advanced training (PhD and PostDoc level) and initiation of undergraduate or Master students to research, dissemination and outreach of R&D results and data with promotion of scientific and technological culture, technology transfer (patents, prototypes or products, spin-offs), social/economic relevance to society of the CONSTRUCT activity is good.

Only a couple of specific cases of competencies of very good quality can be detected, respectively in the fields of seismic engineering and of rail transportation systems.

Response to specific problems of public interest or to societal challenges can be considered good, as the problems of risk mitigation and safe/efficient transportation systems are very demanding in many countries. The international partnerships of CONSTRUCT are of good level and the initiatives aiming at attracting resources for R&D activities from private sources or from outside Portugal are satisfactory. Finally, we believe that the research approaches and methodologies, also in the future, could bring to interesting perspectives in R&D.

The global scientific and technical merit of the team of Integrated Researchers of CONSTRUCT in the application can be considered of good level, with a number of very good scientists. There is evidence of a very good national recognition and of a good international reputation. The nature of the R&D activities of CONSTRUCT may have good impact in

society. Research team talent or competencies of very good quality can be detected only in the field of earthquake engineering and railway engineering.

Description of the objectives and strategy of the CONSTRUCT R&D Unit for 2018-2022 has been done consistently. Regarding the core R&D activity, six thematic research lines will be pursued in the 2018-2022 period. These are the following:

TL1-New construction materials. Recycling and valorisation;

TL2-Built historical heritage. Preservation, natural actions and climate change;

TL3-Safety assessment and seismic engineering. Modelling and testing;

TL4-Assessment and structural health monitoring (SHM) of energy and transportation infrastructures;

TL5-Railway infrastructures;

TL6-Efficient and smart constructions.

Within the next 5 years, CONSTRUCT will keep a logical and sound matrix form of organisation, which revealed quite positive in the past three years. In fact, CONSTRUCT has 6 Research Groups (LABEST, LESE, VIBEST, GEO, LFC and GEQUALTEC), which represent the scientific competences achieved in the past and that provide the human resources, the scientific equipment and tools for the development of the research activities. These six research groups will contribute to fulfil the six thematic objectives previously described with different intensities, ranging from 1 (minimum) to 4 (maximum).

However, the added value of belonging to a large Unit appears only marginal, as emerged during the site visit.

The organization of CONSTRUCT will include the following entities: (I) the Scientific Coordinator, responsible for the coordination and management of the Unit resources, who chairs the Management Board and the Scientific Council; (II) the Management Board, integrated by the Principal Investigators of all Research Groups, which will implement the scientific strategy approved for the R&D Unit; (III) the Coordinators of Thematic Lines, senior researchers chosen by the Management Board that coordinate the scientific contribution of the several Research Groups to each TL; (IV) the Scientific Council, formed by all the PhD Integrated Members of CONSTRUCT, which elect the Scientific Coordinator, approve and change the Unit Rules of Procedure, approve the strategic plans and review the report of annual activities of CONSTRUCT; (V) the External Advisory Board, composed by 3 prestigious foreigner researchers, which will scrutinize the Unit operation and will provide scientific advices on the plan of activities and on the report of annual activities.

Ethical issues are well addressed in the proposal.

During the site visit, all the labs where visited and the ongoing research was described by the involved people. The impression of scarce interest towards technology transfer came out of the meetings and during the presentations of the Unit.

In conclusion, the configuration and organization model of the CONSTRUCT R&D Unit should be suitable to its objectives and R&D activities. The scientific objectives appear interesting both at the national and at the international level. However, the experimental activity is carried at good level but the theoretical modelling behind appears weak and should be strengthened.

The number of PhD students requested appears too high compared to the employment possibilities of academia and civil engineering industry and also considering the actual need of high-profile scientists in the ongoing research. The lack of technicians, on the contrary, has been evidenced in the Labs and should represent a major concern for an adequate development in the future.

Moreover, the profiles for the three Post-doc positions required are not fully described and no indication was given about the scientific areas where they should be inserted.

The PhD students are not presently asked to publish journal papers during their studies. We suggest that in the future the PhD students publish journal papers during their 3- or 4-years study. Also, it would be desirable for them to spend an adequate number of hours by teaching in university classes, to develop soft skills that could be necessary in the academic career. Finally, the international experience of the students should be encouraged by their supervisors. We advise that PhD researchers start, immediately after the thesis defense, to apply for ambitious grants, like, e.g. Marie Curie grants. Regarding all the components of recommended Programmatic Funding, we put into evidence that the Unit did not make any request about support for internationalization and other expenses (i.e. point 14.3 and 14.4 are left empty).

The number of 24 PhD scholarships requested for the Doctoral Program in Civil Engineering (PRODEC) appears too high, and only 7 PhD fellowships can be funded given the allowance for all areas in this FCT Program.

The three positions required at the Post-doc level are neither identified nor described with regard to their activity in specific research groups, however one is funded to support the development of the Unit.

Evaluation Panel: ENGINEERING SCIENCES AND TECHNOLOGIES - Civil and Geological Engineering

R&D Unit: Instituto de Investigação e Inovação em Engenharia Civil para a Sustentabilidade (CERIS)

Coordinator: Jorge Manuel Calção Lopes de Brito

Integrated PhD Researchers: 83

Overall Quality Grade: EXCELLENT

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 5
- (B) Merit of the team of Integrated Researchers: 5
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 4

Base Funding for (2020-2023): 1338 K€

Recommended Programmatic Support

PhD Fellowships: 15

Programmatic Funding: 1400 K€, including for 5 (4 Junior, 1 Auxiliar) New PhD Researchers Contracts.

Justification, Comments and Recommendations

Overall, the CERIS addresses significant and timely issues of national and international importance, particularly focusing on four key cross-discipline thematic strands: (1) Product Development in Civil Engineering Industries; (2) Risk and Safety in Built and Natural Environments; (3) Rehabilitation of Built and Natural Environments; and (4) Response to Natural and Societal Changes. This set of interdisciplinary problems is well justified and supported by active research directions of the CERIS.

To tackle the cross-discipline thematic strands, CERIS combines six research groups representing a wide spectrum of civil engineering disciplines and covering (1) Hydraulics; (2) Environment and Water Resources; (3) Systems and Management; (4) Transport Systems; (5) Construction; and (6) Structures and Geotechnics. The group membership is not homogeneous and ranges from 6 to 28. The key performance indicators such as high-quality publications, PhD training, research income, and international activities are strong, although there are some certain differences across the research groups. In terms of original journal publications and defended PhD dissertations, the Hydraulics Group is leading, followed by the Environment and Water Resources Group and Systems and Management Group. Although these groups appear to be the smallest, in terms of normalised (per member) main performance indicators, they are most productive. The Structures and Geotechnics Group seems least efficient in PhD training, having at the same time a good rate of 2.1 publications per year per staff member. Across the groups, the publication productivity varies from 1.7 to 3.3 papers per year per group member. These values are within a range expected from a highly performing research establishment in civil engineering, particularly bearing in mind that publication (and citation) rates in civil engineering are typically lower compared to other engineering areas. In relation to PhD training, an appropriate measure to consider is the number of completed PhD dissertations per year per group member. This metric varies across the groups from 0.17 to 0.51. Considering that the typical value of this metric in high-performing research organisations exceeds 0.40-0.50, it can be concluded that best performing groups in terms of PhD training are Hydraulics; Transport Systems and Systems and Management. The meeting with PhD students and postdocs demonstrated that they are highly motivated emerging researchers who enthusiastically participate in all CERIS activities.

All research groups are fairly active in relation to advancements of fundamental knowledge; wide-ranging academic, social, economic impacts; high-level publications (>2 papers/staff/year); international visibility in terms of collaborations (e.g., EPFL, MIT), organised conferences, and international (mainly EU) projects; PhD training (CERIS runs six FCT doctoral programs) and Master programs; and active involvement in knowledge and technology transfer (e.g., activities in South American countries).

The selected five major representative achievements relate to hydraulics of pipe systems; transportation systems; recycling waste for concrete and mortar production; composite systems; and thin-walled structures. The successes in these areas are indeed very significant on all fronts, from high quality journal papers to considerable impacts on relevant branches of national economy and industries. It is also worth highlighting CERIS works in the area of environmental hydraulics where its researchers achieved considerable international recognition, which is also reflected in high numbers of international publications, international research projects, advanced summer schools for PhD

students, and contributions to international networks and organisations. This area of research can be defined as world- or at least internationally- leading.

The team of CERIS integrated PhD researchers is well balanced and consists of senior members, researchers at an intermediate stage, and early career researchers. Most international recognition and impact in terms of leading roles in international organisations, keynote lectures, advisory boards, journal editorships, international awards, and membership in learned societies are brought by senior members, as one would expect. Nevertheless, there are noticeable accomplishments that are associated with middle-career and early stage researchers. For example, Dr R.M.L. Ferreira (middle-career researcher, Hydraulics Group) is Vice-Chair of the IAHR Committee on Experimental Methods and Instrumentation, an Associate Editor in two leading hydraulic and water journals (*Advances in Water Resources* and *ASCE Journal of Hydraulic Engineering*), and regular keynote speaker at international hydraulics conferences (e.g., TURBINTERMARS; M.S. Yalin Colloquium). He initiated and completed a number of international projects (e.g., ITN Marie Curie Seditrans FP7-PEOPLE-2013-ITN- 607394) serving as a Principal Investigator or workpackage leader as well as organised a series of international hydraulics summer schools for PhD students. Although an early career researcher, Dr P.T.F. Simões (Systems and Management Group) has already developed a strong publication record with citation indicators comparable to senior researchers; he has been recognised with UTL-Deloitte 2011 Award.

The proposed objectives, overall strategy, and plan of activities for 2018-2022 are firmly based on the achievements of the previous five years and represent a logical development for the next five-year period. The intention is to refine the work focus on most relevant and challenging civil engineering issues of the forthcoming decade, particularly related to safety and security, heritage rehabilitation, eco-efficient materials, novel solutions and technologies, environment and pollution control, hydraulic infrastructure and water resources and services, urban and regional systems, and mobility of people and freight, among others. The work on these cross-discipline problems will underpin wide ranging interdisciplinary activities including developments of strategic environmental assessments, systems modelling and optimization, decision processes, relevant public policies and governance issues. Among the key CERIS goals for the next five years is “to strengthen its global impact in areas where international leadership has been attained or is achievable.” To achieve this goal, the following specific objectives are proposed: (i) to promote trend-setting and leading research based on PhD programmes and research projects; (ii) to transfer CERIS’ expertise through specialized training, services and consulting; and (iii) to ensure a wide dissemination of CERIS’ results. The main goal, specific objectives, and the CERIS strategy can be considered as fully appropriate. The proposed actions in relation to internationalisation, advanced training (at PhD and Master levels), and knowledge and technology transfer continue and expand the approach initiated and successfully maintained in the preceding period. It is also noted that the CERIS intends to significantly enhance activities in the areas of regulatory policies and governance, national and international collaborations (which are already at high level), participation in the key research and industry networks.

The budget requirements for 2018-2022 outlined in the application are reasonable and reflect the current state of affairs and ambitions for 2018-2022. The main budget items in terms of Programmatic Support include 48 PhD studentships and 8 new PhD researchers. The funding is also requested for internationalisation work (80K€), participation in international networks (432K€), and upgrade of facilities and instrumentation (825K€ from FCT). The requested upgrades relate to both modernisation of outdated conventional equipment and development of new experimental capabilities. Among them are a set of advanced Particle Image Velocimetry and laser Doppler velocimetry systems that should put the Lisbon water research to a new quality level, and the CERIS researchers are ready to take full advantage of these capabilities. Overall, the justification for the requested base funding and programmatic funding is convincing, although some items may not be considered fully aligned with modern research trends.

The 15 PhD studentships are to be allocated to the PhD programs as shown below:

1. Civil Engineering = 9
2. Transportation Systems = 3
3. River Restoration and Management = 2
4. Climate Change and Sustainable Development = 1

The allocated PhD scholarships are to be used for strengthening the cross-discipline and cross-group research activities, particularly at the interfaces between different subject areas.

The allocated positions are to be used for strengthening the cross-discipline and cross-group research activities, particularly at the interfaces between different subject areas.

Regarding other Programmatic Funding, the Panel recommends that about 225K€ be used to purchase a universal testing machine for the Structures and Strength of Materials Laboratory, about 37K€ for purchasing a 400 I

environmental chamber for the Construction Laboratory, about 244K€ are to be used to advance capabilities of Hydraulics Laboratory for flow characterization and turbulence assessment. It includes time resolved tomographic Particle Image Velocimetry System and a 2D Laser Doppler Velocimetry System (both to be customised and assembled as required), about 37K€ to develop instrumentation for studies of porous media and fluid fluxes in porous materials in the Geotechniques Laboratory, about 57K€ to purchase a new air compressor system to support experimental laboratories.

Evaluation Panel: ENGINEERING SCIENCES AND TECHNOLOGIES - Civil and Geological Engineering

R&D Unit: Instituto para a Sustentabilidade e Inovação em Estruturas de Engenharia (ISISE)

Coordinator: Paulo José Brandão Barbosa Lourenço

Integrated PhD Researchers: 59

Overall Quality Grade: VERY GOOD

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 4
- (B) Merit of the team of Integrated Researchers: 5
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 4

Base Funding for (2020-2023): 834 K€

Recommended Programmatic Support

PhD Fellowships: 8

Programmatic Funding: 965 K€, including for 2 (1 Junior, 1 Auxiliar) New PhD Researchers Contracts.

Justification, Comments and Recommendations

The Institute for Sustainability and Innovation in Structural Engineering (ISISE) at the Universidade do Minho is dedicated to the field of Civil Engineering, with a focus on structures and infrastructures, sustainability, innovation and advanced technology and on the conservation/rehabilitation of the built environment. The ISISE is a joint venture with the University of Coimbra.

The major scope of the Unit is developing innovation in Structural Engineering, with well-equipped and complementary recent laboratory facilities, with a total area about 5.000 m². The overall approach of ISISE includes aspects such as advances in experimental and numerical techniques, product development and technology transfer to the industry, durability and reliability, recycle, reuse, conservation and rehabilitation, condition assessment, and risk assessment (i.e. aligned with visions from the European Construction Technology Platform).

The Unit is now organized in 4 Research Groups related to Functional Performance (FP), Historical and Masonry Structures (HMS), Structural Composites (SC), and Steel and Mixed Construction Technologies (SMCT). A Management Board (Directors and Coordinators of each group) manages the Unit. The scientists and engineers belonging to ISISE rank at the highest in publications and citations in their research domain (e.g. 524 papers were published in ISI journals, average Scopus h-index of research group leaders is 27, citations in Google Scholar is 23k, 8 patents were filed in the period). Moreover, the leader scientists of the Unit serve as Editors of prestigious journals and leaders of international committees.

The main contributions of ISISE in the period 2013-17, besides training high qualified technical and scientific leaders, are divided in 4 scientific advances:

- (a) noise and vibration,
- (b) masonry mechanics
- (c) innovative construction and retrofit systems
- (d) steel structural stability.

The most relevant results can be evidenced in the areas of computational mechanics of masonry structures and structural stability of steel members, where the Unit has gained a worldwide reputation both at the scientific level (with PhD training and top journal publications) and at the technology transfer level, with a great number of funded projects with large impact on structural codes and innovation. The results in the other two fields appear, however, of medium-good level.

The current contracted funding for ISISE is 14 M€ which represents a very good result in the European ranking of engineering research Units.

The overall judgement on publications, advanced training (PhD and PostDoc level) and initiation of undergraduate or Master students to research, dissemination and outreach of R&D results and data with promotion of scientific and

technological culture, technology transfer (patents, prototypes or products, spin-offs), social/economic relevance to society of the ISISE activity is Very Good.

A specific case of competencies of exceptional quality or value can be detected in the field of historical constructions. The international MSc SAHC devoted to historical constructions, supported by cutting-edge research in the field, received one of Europe's most prestigious prize in the field of cultural heritage. ISISE MSc alumni are leading academics in many countries, and have been hired by leading international companies, research labs and Universities as PhD students/postdocs.

Response to specific problems of public interest or to societal challenges is very good, as the problems of architectural heritage and new construction techniques are very demanding in many countries due to economic issues, ageing, earthquakes and climate change. The international partnerships of ISISE are outstanding and the initiatives aiming at attracting resources for R&D activities from private sources or from outside Portugal are satisfactory. We believe that the research approaches and methodologies, will bring to groundbreaking perspectives in R&D also in the future.

ISISE has 59 integrated PhD members (64% faculty and 36% post-docs) and 84 integrated researchers. The total number of researchers, including PhD students in other institutions and other junior researchers, is 181. 56% of the PhD diplomas were awarded to non-portuguese students. A strong shift to postdoctoral collaborators can be observed in the 2013-2017 period, with 21 postdoctoral collaborators who are given ample independence, co-supervising MSc and PhD students, and leading research projects on their own.

The global scientific and technical merit of the team of Integrated Researchers of ISISE in the application can be considered of highest level, with a number of excellent scientists. There is evidence of a very good national recognition and of an excellent international reputation for the leading members. The nature of the R&D activities of ISISE may have good impact in society. The R&D activities in the period 2013-2017 have been quite important, however with a marginal impact onto societal issues. Research team talent or competencies of exceptional quality can be detected in the field of structural assessment of architectural heritage buildings and steel constructions. Actions towards a wider diffusion of results should be pursued in the future.

Description of the objectives and strategy of the ISISE R&D Unit for 2018-2022 has been done consistently. The vision of ISISE for the new period is to increase the structural and functional performance of Civil Engineering Works and Construction Products, from materials to integral systems with a holistic life cycle approach. The societal challenges of security, industry 4.0, blue economy, energy, cultural heritage, cities of the future and the effects of climate change are considered as the wider goals of ISISE. Its practical activity, however, includes narrower fields such as Functional Performance of Structures, Historical and Masonry Structures, Structural Composites and Steel/Mixed Construction Technologies.

The support actions for the strategic plan include research, training and technology transfer, with a strong focus on the relations with industry and national stakeholders and on national and international dissemination initiatives. In order to keep its high standards and maintain its staff, ISISE will participate to research funding application for International and National calls, will apply for applied research projects with private companies and look for research funds from consulting activities incorporating research and knowledge transfer. The aim is to provide funding in excess of 3 M€ per year in order to allow hiring, per year, at least 25 PhD students and 4 postdocs, to ensure financial support for experimental tests, and to maintain and acquire equipment & software. At the same time, the budget plan aims to maintain the ratio of 0.33 postdocs/faculty-member and reach a ratio of 0.67 PhDs awarded/faculty-member/year in 5 years (currently 0.5).

T

he researchers will be organized into four Research Areas and a sound governance model is envisaged. A new strategy will be to hire members in emerging fields in which critical mass is lacking in ISISE at independent research level, which do not coincide with the areas needed for PhD students: these areas are life-cycle assessment, innovative materials and systems, sea infrastructures and acoustics & energy efficiency.

ISISE claims that they will maintain the ratio of 3 ISI papers per year/faculty member, also increasing the participation of the ISISE members on the most reputed international technical and scientific committees. Moreover, ISISE will continue its strong training activity, by graduating at least 90 MSc and 15 PhD students per year, in strong cooperation with industry. ISISE will foster its direct involvement in the construction sector, including contractors and companies related to timber and carpentry, building services, metals, architecture and engineering consulting, building materials, environment (energy, water, waste, ports, logistics, etc.) and transportation (roads, railways, mass transportation, etc.).

The 5-year expected funding, including FCT funding, is about 90% of the previous 5-years, which seems plausible and adequately justified. The proposed budget includes 32% of the total for internal and external human resources. The costs for adaptation of facilities and buildings (10%) are partially justified by the need of growing facilities of ISISE: in Guimarães a new area for testing and constructing specimens in open space has been assigned and in Coimbra the FireLab requires additional adaptation of facilities in order to reach full accreditation of the various standardized tests.

During the site visit, all the labs in Guimarães were visited and the ongoing research was described by the involved people. The impression of a good interest towards technology transfer came out of the meetings and during the presentations of the Unit. Regarding the synergy between the four groups, we learned that cooperation is very strict among the groups belonging to the same university. The cross cooperation among the two universities is less active, however there are some PhD students supervised by professors of both universities.

We believe that the configuration and organization model of the ISISE R&D Unit should be suitable to its objectives and R&D activities. The scientific objectives appear ambitious and interesting both at the national and at the international level. Personnel hiring strategies are very interesting and innovative. Budget organization requires some clarification. The ethical issues are correctly addressed in the proposal.

Finally, we put into evidence some overlapping with the CTAC Unit, especially in the field of Acoustic and Energy Efficiency, and Life-Cycle Assessment of Construction Products and Systems, Active Ageing.

ISISE asked for 16 PhD students. Eight students are indicated for the PhD program in Civil Engineering at the University of Minho and the other eight students for the PhD program in Steel and Mixed Constructions at the University of Coimbra. PhD students at ISISE are pushed to publish papers during their studies on ISI journals. Participation to conference and to other activities (like dissemination, preparation of project proposals) is mandatory. On the other hand, they are not required to teach. In the previous period, 50% of the PhD laureates went to the industry and construction job market and approximately 20% continued research activity in the two partner universities. The PhD students were very positive about their activity during the meeting. We suggest to stimulate them to teach into classes.

The strategy of ISISE is to hire 5 Post-Docs members in emerging fields in which critical mass is lacking in ISISE at independent research level, which do not coincide with the areas needed for PhD students. ISISE will ensure 1/3 of the cost as co-funding, using its base funding. 3 contracts are to be initiated in 2019 and 2 contracts are to be initiated in 2020, with the duration of 3 years. 3 are at Junior and 2 are at Auxiliary Researcher level. Their pursued activity is well described.

However, we believe that having just a single Post-Doc in a single area will not allow to boost research in a totally new area and that the Unit should put larger efforts to start up activity in these new research areas. We also wish to advise that PhD researchers start immediately after the thesis defense to apply for ambitious grants, like, e.g. Marie Curie grants.

The success of the UNIT in competitive EU R&D projects (e.g. the H2020 Seismology and Earthquake Engineering Research Infrastructure Alliance for Europe) strongly relies, in fact, on top-level experimental facilities. Purchase of new structural, mechanical, thermal/acoustic and geotechnical testing facilities is therefore indicated. The requested equipment (total of 990 k€) is directly oriented towards the successful completion of the objectives and strategy of the R&D Unit for 2018-2022. However, we consider that some items of the second batch of equipment (laboratory mechanical testing) have secondary importance and, at the same time, we consider as secondary the third batch of equipment for acoustic and thermal testing.

Evaluation Panel: ENGINEERING SCIENCES AND TECHNOLOGIES - Civil and Geological Engineering

R&D Unit: Riscos e Sustentabilidade na Construção (RISCO)

Coordinator: Paulo Barreto Cachim

Integrated PhD Researchers: 23

Overall Quality Grade: WEAK

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 3
- (B) Merit of the team of Integrated Researchers: 2
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 2

Justification, Comments and Recommendations

The R&D Unit RISCO - Aveiro Research Centre of Risks and Sustainability in Construction formally started its activity in January 2015. The Department of Civil Engineering (DECivil) of the University of Aveiro hosts RISCO and most of RISCO's members belong to DECivil. The origins of the R&D Unit go back to 2011, when the DECivil decided to organise its research into three research areas that were considered relevant for the forthcoming years: i) risks in the built environment; ii) sustainability in construction; and iii) built heritage conservation and restoration. The RISCO Integrated Research staff are grouped within these three areas of competence.

Although the name of the centre implies that the first theme is the primary area of research group, the work being done by this R&D Unit on "risk"-related topics does not have high visibility. Only 20% to 25% of the overall research efforts and published papers are related to this theme. Of the five key papers listed in RISCO's report to FCT, only one is directly related to risk assessment.

The overall RISCO research directions address the challenges in civil engineering in the local community. For example, the research on conservation of façade tiles in historical and heritage building is innovative with obvious societal applications. However, the work seems to be based purely on laboratory experiments, with no theoretical scientific framework behind it. Overall, the research done at RISCO has some impact on national scale (especially in the local community), but their international impact is limited.

The Panel noted that, up to now, there seems to be little interaction and synergy among the three main R&D Units at RISCO. Regarding journal papers, the integrated researchers at RISCO (23 at the time of the evaluation) are quite productive, publishing about 70 articles in peer-reviewed journals each year. However, only 15-20% of these articles are result of collaboration between researchers from different Units with RISCO. Furthermore, there is insufficient international visibility and impact in the area of "Risks in Built Environment". Most of the research activities in this area were initiated as small internal projects within RISCO and it was not clear to the evaluation committee what efforts are being made to increase the participation of RISCO in national and European projects in this area.

The five contributions identified in the application as most important relate to (1) Contribution to policies of risk mitigation and assessment, (2) Contribution for improved design rules for structures subjected to accidental actions; (3) Contribution in the development of construction materials and systems for a circular economy, (4) Contribution in the functionalization of construction materials and systems to achieve better and sustainable performance, and (5) Contribution for policies in built heritage conservation. All these contributions are valuable services to the society, but have marginal scientific value.

Regarding dissemination of knowledge and international contacts, it is noticed that in the period 2013-2017, RISCO organised several national and international conferences, such as the 4th and 5th edition of the Congress of Innovation in Sustainable Construction (CINCOS) in 2014 and 2016; the organisation in 2017 of CREPAT (Built Heritage Conservation Congress) that was considered a landmark in the dissemination of scientific works in the area; and the International Forum & Conference of Architectural Heritage Portugal-Brazil, which is an annual interinstitutional debate forum that takes place in Portugal and Brazil.

There are some issues with objectives, strategy, plan of activities and organization. The goals set for the R&D Unit for 2018-2022 are quite ambitious, but it is not clear how they can be achieved. The strategy seems to be continuing the present research activities without any change of direction or scientific focus. It was also found that there is no

systematic programme for integration of PhD students under RISCO umbrella in the form of activities that would increase the cohesiveness of the group. The scientific contacts among the PhD candidates themselves is informal and there is very little interaction among the groups in form of regular seminars where the PhD candidates present and discuss their research.

More importantly, little is done in terms of the critical assessment of the current situation, identification of the research teams of actual international significance within RISCO, and selecting specific areas of strength where FCT funding could be directed for developing/maintaining critical mass and strengthening the international position of RISCO. The Evaluation Panel impression is that the plans for 2018-2022 represent 'business as usual' rather than a strategy plan that would be based on proper self-critical assessment of the current situation.

A final observation: it was quite surprising to the evaluation committee that RISCO did not provide any input or opinion in the "Ethical Issues" section of their report to FCT. Any type of research that aims to promote the development of sustainable and resilient cities will impact the lives of people and must consider the potential ethical issues faced in the research.

The evaluation committee recommends that RISCO rethinks its long-term strategy on several fronts. First, it should focus its efforts on better integration of the three research groups into a coherent centre with a strong scientific identity. This would mean focusing more on establishing the scientific framework for their activities and seeking funding through international programme like H2020 and the upcoming Horizon Europe. Second, it should work more closely with end-users (like insurance companies) and stakeholders for their risk-related projects. To justify to the name of the centre and provide a sense of identity, they could, for example consider developing a RISCO framework for assessment of risks in the built environment. Finally, RISCO should pay more attention to career development of its young researchers and organise regular scientific and social activities that would increase the sense of identity in the group.