Engineers for Low Carbon

The JBM were of the view that the low carbon agenda is part of the sustainability agenda and therefore is covered by the guidelines on sustainability. The guidelines make reference to the low carbon agenda *and how it impacts on engineering design, construction and operation* (under knowledge and understanding). There is no specific reference to the intellectual ability, practical or specific skills in relation to the low carbon agenda. If society is to achieve a lower carbon cycle, there is an even greater need to reinforce holistic and joined up thinking across the traditional boundaries of civil engineering and this means the deployment of teaching resources with the support of Industry to drive open leaning through increased rigorous project work. Lower carbon performance also requires more knowledgeable links between economic and social infrastructure, energy, water and waste and the natural and built environment to achieve 2050 performance targets as well as the skills to measure the CO2 inputs and outputs. The central aim is for resource and energy efficiency where sustainability adds the qualification to this of environment, economics and social benefit.

The low carbon agenda is a subset of the sustainability agenda but unlike much of the sustainability agenda it is possible to measure the impact of low carbon directly since the carbon count is directly related to the fossil fuel energy used in capital and operational aspects of civil engineering. Hence industry is rapidly developing tools to deal with this. Further, the low carbon agenda in construction is a key government policy which suggests that existing students will be entering industry at the time that carbon critical design and construction will be becoming core performance indicators and design criteria.

We are entering a time of rapid change, the low carbon agenda being an example of such a change. The implication for graduates is that they will have to cope with those changes. For example, it will no longer be acceptable to develop codes of practice over many years. Hence there will be greater reliance on information monitoring (known as BIM but actually more generally applied to all construction) to monitor performance and provide feedback. Further, there will be an increasing move towards the built environment as a system which means graduates will have to a greater awareness of all aspects of design and construction. For example, structural engineers will have to be familiar with building physics not only in terms of its fit into the structure and the impact it has upon the structural form but also the structure being part of the building physics solution. Civil engineers will need the skills to assess the impact of their constructions and master plans on the Energy needed to drive effective functioning of the Natural and Built Environment. A greater emphasis on rigorous open learning with the support of Industry is also needed here. The establishment of Precedent through measured ‘case studies’ are needed to guide this process as in the teaching of architectural students.

The concept of sustainability is still developing but the carbon agenda has accelerated the process as there is a legislative driver (80% by 2050) and industry is addressing that agenda now. Therefore graduates need to be familiar with the concept of low carbon and how it impacts on design, construction and operation as stated in the guidelines under knowledge and understanding. However, this is not sufficient given the rate of change. Graduates will have to have an ability to use carbon criteria to make decisions. This needs to be identified in the guidelines. The challenge is to identify what needs to be in the guidelines to ensure that graduates have the ability to deal with the low carbon agenda. Industry guidelines do not exist. Hence graduates should be able to:-

- Be able to assess the capital and operational carbon content of civil engineering projects;
- Demonstrate through design work, project, coursework and/or examinations a strong awareness of carbon critical design and construction;
- For those specialising in structural engineering be able to demonstrate through design work an awareness of building physics;
- And those studying the broader field of civil engineering will need exposure to the challenge of configuring (master) plans that encourage holistic design.

Appendix A

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ANNEX C – SUSTAINABILITY IN DEGREE PROGRAMMES

Context

The JBM requires that sustainable development be integrated into existing teaching and learning, and must be pervasive throughout the engineering education programme; a thread of sustainability will therefore run though the programme.

Engineers should be able to respond to societies' concerns about the impact of human activity on the environment. There is an increasing demand from governments and the public that this environmental concern is placed in the context of achieving the correct balance between environmental, social and economic outcomes within the overarching concept of sustainable development. This concern underpins the development of construction in the low carbon economy (see guideline *'Engineers for Low Carbon'*)

Aims

Students will become tuned to the need to design and engineer projects which minimise our impact on the environment, and which enhance humankind's endeavours in a sustainable manner.

Knowledge and understanding

The thread of sustainability running through the programme should enable a student to:

- Be aware of the implications of climate change, international protocols associated with climate change, and the low-carbon agenda and how it impacts on engineering design, construction and operation.
- Ensure that they take account of the context of environmental, economic, political, interdisciplinary, global and social issues, and other dimensions including ethics and environmental justice in dealing with engineering problems.
- Develop an awareness of the use of environmental management systems, environmental impact assessment and social impact assessment and how they are used on engineering projects.
- Be aware of resource scarcity, and the need to limit energy dependence.
- Be aware of sources of environmental, social, political and economic information and their application to the above.
- For those studying structural engineering an awareness of building physics.
- Demonstrate through design studies, projects, coursework and/or examinations a strong awareness of carbon critical design and construction.

Intellectual ability

The student should be able to

- Provide an interdisciplinary perspective on the practical problems associated with

sustainability.
- Appraise build options in the context of the sustainability agenda.
- Look beyond technical design solutions to impacts on local stakeholders.
- Assess and mitigate environmental risk in given examples [1]
- Demonstrate knowledge of energy supply, and waste & water management.
- Demonstrate knowledge of life-cycle assessment, sustainable communities and related infrastructure.
- Develop a holistic approach to design.

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Practical skills

The student should be able to:

- Demonstrate through design work, project, coursework and/or examinations a strong awareness of and commitment to the principles of sustainable development as outlined above.

General transferable skills

The student should be able to:

- Produce solutions to problems which are profoundly interdisciplinary in nature.
- Appreciate the importance to society in general of the impact of human activity on the environment.
- Communicate knowledgeably about sustainability issues especially to those with a non technical background.
- Be able to assess the capital and operational carbon content of civil engineering projects.

Method of teaching, learning and assessment

Teaching of sustainability should be embedded throughout many aspects of the taught curriculum, including design projects, dissertation projects, coursework and examinations. Where the subject forms the focus of a particular unit, case studies of (and site visits to) particularly good examples of projects where the ethos of sustainability has been embraced profoundly should be considered.

The JBM recommends that the three sets of guidelines (Annexes B, C & D) be considered together, especially in relation to teaching and learning methodology and assessment.

[1] For example flood risk including vulnerability of schools, hospitals etc; slope stability and risk.