



## 2. 'Person-Centredness' as a Core Value in Design & Construction

These are interesting times - the benefits of modern technology have bypassed and long overtaken the stirring thoughts, visions and catchcries of Architects at the beginning of the 20th. Century. However, at this time in Europe, we must now ask ourselves some difficult questions .....

*"What should be the Design Agenda for the 'built environment' in this new millennium ? "*  
*"Do we understand the 'real' needs and desires of 'real' people in an inclusive society ? "*

Sustainable Human and Social Development is the declared long term goal of the European Union, as re-stated time and time again in its Treaties, policies and actions. It is Sustainable Design - the art and science of the design, supervision of related construction / de-construction, and maintenance of sustainability in the built and virtual environments - which is currently generating a quantum leap in the forward evolution of a more coherent design philosophy ..... one in tune with the spirit of this age.

Principle 1 of the 1992 United Nations Rio Declaration on Environment and Development states .....

*'Human beings are at the centre of concerns for sustainable development.  
They are entitled to a healthy and productive life in harmony with nature.'*

And the World Health Organisation, in the preamble to its Constitution, defines 'health' as .....

*'a state of complete physical, mental and social wellbeing, and not merely  
the absence of disease or infirmity'.*

Deeply embedded, therefore, within this philosophy is the concept of 'person-centredness', i.e. that core design value which places real people at the centre of creative concerns, and gives due consideration to their health, safety, and welfare in the built environment - it includes such specific performance criteria as : a sensory rich and accessible (mobility, usability, communications and information) environment ; fire safety ; thermal comfort ; air, light and visual quality ; protection from ionizing and electromagnetic radiation ; nuisance noise abatement ; etc. An important 'person-centred' design aid is the questionnaire survey, which is not only a very valuable source of direct information, but also formalizes meaningful consultation between practitioners and end users.

## 3. The Sustainable 'Life Cycle' of a Building

The many actors and disciplines involved in the European construction sector each have their traditional views and opinions concerning the different phases, and the duration, of a building's life cycle. Generically, however, we may identify the following ten segments in a complete cycle .....

- Expressed needs / wants / desires / requirements of the client ;
- Planning brief and performance specification for the building ;
- Site analysis and evaluation ;
- Design ;
- Preparation for construction ;
- Construction ;
- 'Early life' of the building in use - including management, maintenance, servicing ;
- Adaptable 'middle age' of a building in use - including renovation, refurbishment, modification, alteration, and extension ;
- De-Construction ;
- Disposal .

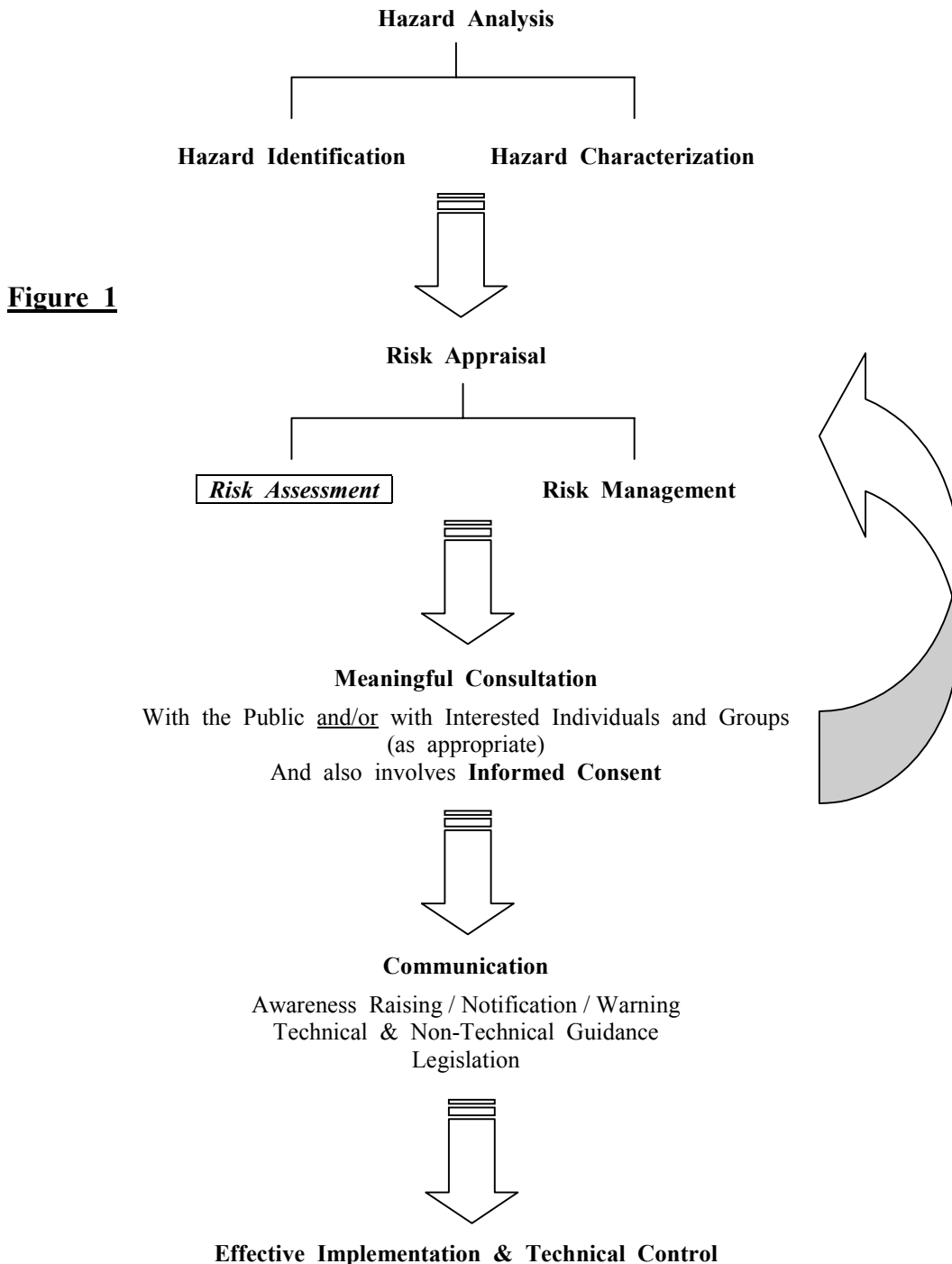
With adequate emphasis placed on 'adaptability' throughout the design stage of a building, and quality of construction on site, it must be a requirement - to realize the target of a sustainable 'built environment' - that the minimum duration of that building's life cycle will be in the order of .....

for structure	100 – 200 yrs ;
for the building fabric	50 – 100 yrs ;
for services	20 – 30 yrs ;
for furniture & fittings	10 – 20 yrs .

**4. 'Protection of Health' & 'Assessment of Risk to Safety' ?**

The many Accession Countries in central and eastern Europe are now completing their implementation of the **acquis communautaire**, i.e. the body of existing European Union legislation. Such is the range of languages, cultures and traditions involved, that the first order of business in any area of technical harmonization related to health protection and safety must be the development of a common understanding in terminology and concepts.

Presented visually ..... what exactly is the relationship between 'health protection' and 'assessment of risk to safety' ?



**Figure 1**

As previously discussed in Liege last year, the level of uncertainty with regard to the hazard of radon in buildings and its serious and irreversible adverse impacts on human health requires that, as mandated by European Union legislation, the 'precautionary principle' be applied .....

***'Where there is uncertainty as to the existence or extent of risks of serious or irreversible damage to the environment, or injury to human health, adequate protective measures must be taken without having to wait until the reality and seriousness of those risks become fully apparent.'***

The 1994 E.U. Energy Charter Treaty, augmented by the 1972 United Nations Stockholm Declaration on the Human Environment, provides us with a definition of 'environmental impact' which binds together protection of the environment and human health .....

***'Any effect caused by a given activity on the environment, including human health and safety (and welfare), flora, fauna, soil, air, water, (and especially representative samples of natural ecosystems), climate, landscape and historical monuments or other physical structures or the interactions among these factors ; it also includes effects on cultural heritage or socio-economic conditions resulting from alterations to those factors.'***

In any particular endeavour, therefore, the following Question must be asked .....

***"Is there a potential for serious or irreversible damage to the environment or health ? "***

Concerning radon protection of buildings, the Design Objective must then be .....

***Protection of Human Health.***

'Assessing risk to safety' is but one element in the middle of an elaborate process ; it is an exercise which is performed prior to 'meaningful consultation' with interested individuals, groups, or society as a whole - whichever is appropriate. And unless there is sufficient reliable data available, this exercise is of little value. 'Protection of health', on the other hand, is the target end condition demanded by European Union legislation.

Points to note with regard to Figure 1 :

- (a) The process illustrated must be transparent ;
- (b) Clear statements on reliability must be made with regard to supporting statistical databases and methods of risk assessment ;
- (c) Statements of uncertainty must accompany calculations ;
- (d) **'Informed Consent'** must be interpreted as 'consent freely obtained - without threats or improper inducements - after appropriate disclosure to a person (or persons) of relevant, adequate and easily assimilated information in a form, e.g. oral, written, braille, and language understood by that person (those persons)'.

## **5. Radon Protection of Buildings - An Emphasis on 'Reliability'**

The initial response of many European countries to the problem of radon in buildings has been to develop 'predictive' National Radon Risk Maps. These are useful design aids in the case of small construction projects ; unfortunately, they are not reliable and the average values shown may actually conceal a considerable degree of variability in the radon concentrations found in completed buildings. Since the Liege European Symposium on Radon Protection, we have been working on mirroring previous efforts in the Czech Republic and Sweden to classify soils according to radon risk. By filling in some pieces on the construction side of the equation, however, a more reliable estimate of Indoor Radon Activity will be facilitated. The Irish Agrément Board partnered this work.

During the autumn of 2001, drafting of Irish Agrément Board Certificate No. 01/0130 was nearing completion. One of the final technical issues to be resolved was that of prescribing the 'effective pressure field' of a radon collection sump. We were aware that the quality of workmanship across building sites in Ireland differed greatly, and we were also aware that installation monitoring in the USA had thrown up widely varying results.

Three categories of construction execution quality were agreed with the Irish Agrément Board :

#### **Category A**

- (i) Supervision of the works is exercised by appropriately qualified and experienced personnel from the principal construction organization ;
- (ii) Regular inspections, by appropriately qualified and experienced personnel familiar with the design and independent of the construction organization(s), are carried out to verify that the works are being executed in accordance with the design.

#### **Category B**

Supervision of the works is exercised by appropriately qualified and experienced personnel from the principal construction organization.

#### **Category C**

This level of construction execution is assumed when the requirements for **Category A** or **Category B** are not met.

This, in turn, permitted us to formulate the following guidance in IAB Certificate No. 01/0130 :

As a general rule .....

- with Category A Construction Execution, allow for one Radon Sump to service an area not greater than **200 m<sup>2</sup>** ;
- with Category B Construction Execution, allow for one Radon Sump to service an area not greater than **100 m<sup>2</sup>** ;
- with Category C Construction Execution, allow for one Radon Sump to service an area not greater than **50 m<sup>2</sup>**.

Recently, we have brought this design guidance to the another level of development :

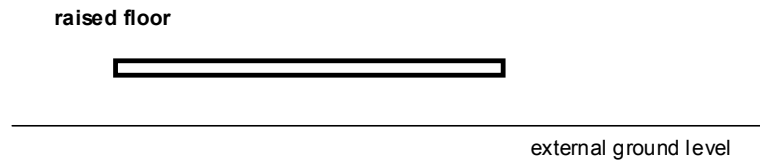
<b>Radon Protection Reliability Matrix - Radon Soil Gas Control System</b>		<b>Building Footprint Categorization</b>								
		Ground Floor Profile I			Ground Floor Profile II			Ground Floor Profile III		
		Quality of Construction Execution								
		A	B	C	A	B	C	A	B	C
<b>Soil Radon Risk Classification</b>	<b>Low</b>	200 m <sup>2</sup>	100 m <sup>2</sup>	50 m <sup>2</sup>	200 m <sup>2</sup>	100 m <sup>2</sup>	50 m <sup>2</sup>	150 m <sup>2</sup>	75 m <sup>2</sup>	N/A
	<b>Medium</b>	200 m <sup>2</sup>	100 m <sup>2</sup>	50 m <sup>2</sup>	200 m <sup>2</sup>	100 m <sup>2</sup>	50 m <sup>2</sup>	150 m <sup>2</sup>	75 m <sup>2</sup>	N/A
	<b>High</b>	200 m <sup>2</sup>	100 m <sup>2</sup>	50 m <sup>2</sup>	150 m <sup>2</sup>	75 m <sup>2</sup>	N/A	100 m <sup>2</sup>	50 m <sup>2</sup>	N/A

**Table 1 ~ Reliability Matrix for a Radon Soil Gas Control System**

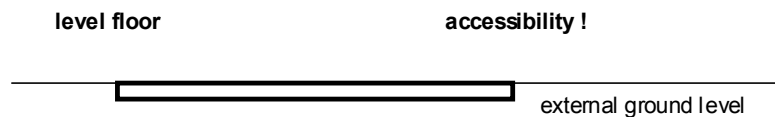
Table Key : Areas shown indicate maximum limits to be serviced by one Radon Collection Sump.  
The central relationship is highlighted by the heavy box in the middle of the Table.  
N/A ..... Not Applicable. Not permitted.

As this work progressed, still another factor had suggested itself - the Building Footprint.

### Ground Floor Profile I

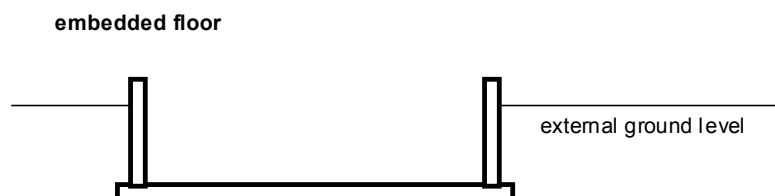


### Ground Floor Profile II



### Ground Floor Profile III

**Figure 2**



Closer examination of Ground Floor Profile III helped to highlight the difference between .....

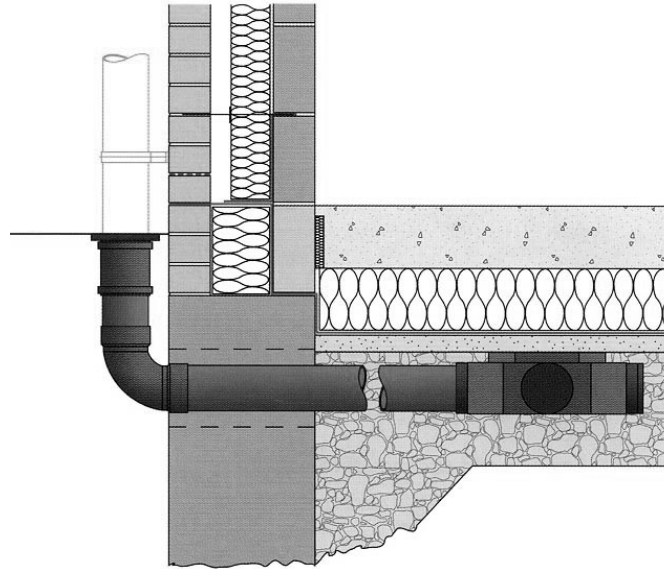
**Radon Resisting Membrane :** A continuous membrane, properly installed on site, the function of which is to resist the passage of radon soil gas (incl. Rn-222, Rn-220, RnD) into a building.

The radon permeability of a 'radon resisting membrane' shall not exceed a figure, taking into account measurement uncertainty, of  $10 \times 10^{-12} \text{ m}^2 / \text{s}$ .

and

**Radon Resisting Barrier :** A radon resisting membrane, or membrane assembly, which is capable of withstanding hydrostatic pressure.

As shown below, detailing of a ground floor construction which incorporates a Radon Resisting Membrane, can accommodate likely construction settlement over the full life cycle of a building, allows for the installation of very high levels of thermal insulation, and permits independent accessibility for people with disabilities requires more than general design input. Figure 3 illustrates a detail having application in Europe (outside seismic zones) .....



**Figure 3**

Accordingly, three categories of suitable design and construction execution quality were developed :

**Category A**

- (i) Design of the works is exercised by an independent, appropriately qualified and experienced architect, with design competence relating to radon protection of buildings ;
- (ii) Installation / fitting of radon-related construction products / systems is exercised by appropriately qualified and experienced personnel, with construction competence relating to radon protection of buildings ;
- (iii) Supervision of the works is exercised by appropriately qualified and experienced personnel from the principal construction organization ;
- (iv) Regular inspections, by appropriately qualified and experienced personnel familiar with the design, and independent of the construction organization(s), are carried out to verify that the works are being executed in accordance with the design.

**Category B**

- (i) Design of the works is exercised by an independent, appropriately qualified and experienced architect ;
- (ii) Installation / fitting of radon-related construction products / systems is exercised by appropriately qualified and experienced personnel ;
- (iii) Supervision of the works is exercised by appropriately qualified and experienced personnel from the principal construction organization.

**Category C**

This level of design and construction execution is assumed when the requirements for **Category A** or **Category B** are not met.

<b>Radon Protection Reliability Matrix - Radon Resisting Membrane</b>		<b>Building Footprint Categorization</b>								
		Ground Floor Profile I			Ground Floor Profile II			Ground Floor Profile III		
		Quality of Design & Construction Execution								
		A	B	C	A	B	C	A	B	C
<b>Soil Radon Risk Classification</b>	<b>Low</b>	Lp RM	Lp RM	Lp RM	Lp RDM	Lp RDM	RDM	RDB	RDB	N/A
	<b>Medium</b>	Lp RM	Lp RM	RM	RDM	RDM	N/A	Hp RDB	Hp RDB	N/A
	<b>High</b>	RM	RM	RM	Hp RDM	Hp RDM	N/A	Hp RDB	Hp RDB	N/A

**Table 2 ~ Reliability Matrix for a Radon Resisting Membrane**

Table Key :	RM	Radon Resisting Membrane
	RDM	Radon & Damp Resisting Membrane
	RDB	Radon & Damp Resisting Barrier
	Lp	Low Performance (robustness)
	Hp	High Performance (radon - with aluminium foil)
	N/A	Not Applicable. Not permitted.

Some further practical issues relating to **reliability** and 'real' construction performance :

- Above small construction projects, the level(s) of radon activity in a site's soil(s) - and foundation hardcore - should be established by means of site investigation and testing ;
- An on-site membrane integrity test, involving the use of an environmentally-friendly tracer gas, should be carried out after membrane installation is completed ;
- Because a viable membrane integrity test can only be carried out between the inside faces of the external walls, hybrid membrane installation should always be considered. A more robust and durable radon resisting membrane should be installed within the depth of wall construction.

## **6. A Common European Technical Agenda**

To ensure there is an adequate support framework in place for the construction sector, therefore, it is advocated that the following initial elements of a **Common European Technical Agenda** on 'radon protection of buildings' be outlined, and agreed as a basis for further positive progress :

- A coherent, **Harmonized European Action Programme** - covering the short term up to the year 2010 ;
- A multi-lingual, **Harmonized European Vocabulary** ;
- A reliable, **Harmonized European Database** of radon-related statistics ;
- 'Person-Centred' Research and Demonstration** which answers the health needs of 'real' people exposed, over prolonged periods of time, to low levels of ionizing radiation, and the practical demands of those who plan, design, construct and manage for protection of that health in the European 'built' environment ;
- A comprehensive array of radon-related **Performance Indicators** - this includes Benchmarking ;
- An effective E.U. regime of **Performance Monitoring and Technical Control**.

## 7. Conclusions

Once again, it must be stressed that there is sufficient objective scientific data available to show that exposure to radon activity, above ambient levels, is harmful to human health. Such is the lack of **reliable information** in Europe, however, that little else can be stated with confidence. In the current legal climate of the European Union, this places the construction sector in a precarious position. The 'precautionary principle' must be invoked to deal with protection of health from radon in buildings.

Since the launch of the 1997 Irish Building Regulations, awareness and experience of this important aspect of building performance has increased throughout the construction industry in Ireland. For building designers and construction organizations alike, the issue of 'real' construction performance **reliability** is also the important challenge; and a 'reliability-based' and 'person-centred' approach is now necessary to provide the practical solutions.

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