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### **“SPACE BAR ONE” - A STRATEGIC BRIEF FOR LEISURE DRINKING SPACE IN COMMERCIAL SPACE FLIGHTS**

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#### **ABSTRACT**

This paper begins by asking the question “if a Space bar was to be built tomorrow, what would it be like?” With the predicted imminent bloom of space tourism and its associated industries within the next couple of decades, aerospace professions are faced with the challenge to deliver increasingly complex spatial programs for the upcoming market of commercial spaceflights, with an aspiration for a much better quality of living than what is available today. This paper strives to discuss the likely identity and characteristics for a “Space bar” in the context of future commercial space flights. The scope will focus on the near future period when space tourism industry is set to bloom rapidly. Taking references from the design principles behind contemporary bar design, this paper attempts to establish a framework of relevant issues that should be considered throughout the design process. The paper will begin with some of the prerequisite conditions that would make “Space bar” a feasible concept. These include technical as well as medical issues that must be resolved at the outset. The discussion will follow by describing how some of these factors will have significant impacts on the “Space bar” design.

The microgravity environment would certainly make for a genuinely unique leisure drinking experience. However it also presents some significant challenges to the human factor aspects of design. This paper strives to make suggestions on how the microgravity environment could bring unique experience and opportunities to the future space tourists, without the requirement of extensive pretrainings. The novelty of a “Space bar” is more than just a leisure module which adds values to the commercial space flights. Through branding in association with mainstream consumer products, the operation of a “Space bar” has real market potentials to generate some very substantial business opportunities in conventional markets. This paper will briefly discuss these opportunities, and how they may become the key business model that could make the “Space bar” economically viable at a much earlier time. The paper will conclude with a selection of summarising diagrams and a list of recommendations and guidelines for future Space bar design based on the study.

#### **Introduction**

This paper strives to contribute to the space sector by discussing the various aspects regarding the design of a “space bar” – a habitable space or “program” that is dedicated to add values to the experience of space tourism.

Almost half a century has passed since the beginning of the age of human spaceflights, much has happened as well as changed in the space in-

dustry. Since the turn of the millennia the number of private and commercial enterprises working in the space sector has been rising rapidly, all trying to grab a share of the emerging market of space tourism. At present, much of the emphasis still lies on the capability to provide access to space. However, as the technologies become more mature and widely available, the next logical step would be to improve on the space tourist experience.

This paper does not promote a specific design solution for a space bar, instead the paper intends to convey the key design processes for a space bar that would satisfy the client's needs. This process is usually referred to as the strategic briefing in architectural terms.<sup>1</sup> By communicating with the client at the beginning of a project and to have a better understanding of the client's background and ambitions, an architect could generate a strategic brief based on the preliminary information and list out precisely what the client needs and what the available options are. Once the client has considered his/her options and has signed off the strategic brief, the architect could then proceed with the design process which would eventually lead to a design solution.

This brief-finding exercise is a critical step within the whole design process. It ensures that the clients have a better understanding of their own goals and can differentiate between their needs from their desires. For the designers, strategic briefing makes sure that their design solutions are truly responding to the clients' needs.

There are numerous references to the human factor aspects of beverage consumptions in previous and current spaceflight missions. However, since the existing beverage consumption systems were ultimately about supporting scientific and exploratory missions, their designs are not seriously concerned with the experience of beverages consumption any more than whether it satisfies the fluid consumption requirements.

And as such they were not designed to engage with other human senses such as vision, smell, sound and feeling, all of which contribute significantly to the whole drinking experience, which is what the design of a space bar should be about.

### **Prerequisites**

Before any more bold statements regarding various aspects of design of a space bar is made, it is necessary to point out that the discussion in this paper is based on the assumption that the following conditions have been completely satisfied:

#### **1: space tourism is going to happen**

In any case this assumption has already turned into a fact; Commercial enterprises such as Virgin have already been offering sub-orbital flight tickets to the general public, for those who can afford it.

Private companies such as Bigelow are hard at work to become the first to have the capacity to deliver a space hotel. Even national space agencies are now looking seriously at how to adjust and adapt their capacity in order to capitalise on the emerging market. In short, the development of the space tourism industry has already begun. It is only a matter of time for the market to mature enough to cater for a wider demography of clients.

#### **2: No “showstoppers” regarding the concept of beverage consumption for leisure purposes under microgravity environment.**

This assumption is particularly concerned with the medical and technical issues related to drinking in space. Although the act of drinking has been done in microgravity conditions many times before and it has been part of the astronauts' daily routine since the dawn of the space age, our understanding of how the digestive system of human body reacts to microgravity is very limited. At present there are studies trying to look at how substances such as caffeine and alcohol affect the human body under the weightless environment. However, the results are so far inconclusive due to the limited opportunities for real spaceflight data and experiments.

There are also studies carried out looking at how microgravity could affect certain chemical processes such as fermentation, carbonation and frothing, which are all critical processes for producing beverages such as beer and carbonated drinks. Again much of these findings are still at the preliminary stages and more research on the topic is needed to see if these technical difficulties can be resolved.

#### **3: The enabling infrastructure for a space hotel is in place**

Leisure orientated design such as space bar relies on the support of the other spaceflight systems to deliver its intended function. In fact the supporting infrastructure should be considered as part of the pre-requisites. The infrastructure should include the means of safe and reliable transport to and from the orbital space, and the space industry should have the capacity to provide an acceptable level of critical habitation functions in space, such as power supplies, life-support system and radiation protection, etc.

## Space Bar as a Typology

A bar is a design feature where people gather and drink. It can be a venue where the customers can relax and enjoy the passing of time. It can be a place for observation. It can also be a spot to make new friends, or to socialise with those you are familiar with. And for the purpose of this paper, the beverages involved are not necessary alcoholic based. The functions of a bar vary, depending on its local environment, culture, and its customer communities. The differences in contexts have led to a broad diversity of bar design. In any case, the design of a bar tends to be specialised to cater for particular client groups.

A space bar is similar to its conventional counterparts in many ways; It is catering for a very specific client group, with its ultimate aim being to deliver an enjoyable leisure and social experience to its clients. However, there are also some significant differences between how a space bar operates in comparison to its conventional counterparts. Listed below are some of the more prominent distinctions:

Firstly, the microgravity environment would have a major impact on the practical operations of a space bar. All actions and activities that are involved in the space bar operation would require a fundamental rethinking of how to perform under weightless conditions. This would be further discussed in the later section “analytical studies of space bar programs”.

Second, the act of going to a space bar would be much more deliberate when compared to the casual and often spontaneous nature of walking into a nearby bar on Earth. One may even have to decide what drinks they would like to drink months ahead of their journey into space. The premeditated quality of a space bar resembles attending an event such as a ball or a concert.

Last but not least, since the start up costs for a space bar would be much higher than a conventional bar on Earth and it is likely to have a costly upkeep, the classic business model for a bar to be sustained solely by its sale of beverages is not applicable. The cost may be justified by considering its added value to a private property, much like how a bar is often seen as part of a marketing package for a luxury yacht or a private mansion house. Alternatively, it may be marketed as a tour-

ist attraction itself. In any cases, a space bar is likely to require a radically different business approach to ensure that it is economically feasible.

## The “Programs” of Space Bar

A space bar design should not be solely about the setup of the beverage dispenser and its associated hardware - since that is only the mean and not the cause. The ultimate goal of the design should be about the delivery of the desirable leisure drinking experience. This is only achievable by taking a holistic approach towards all the functions and activities taking place in relation to the clients. It is necessary to understand the relationship between each of these functions or “programs”, of how they affect and interact with each other, so that the space bar design could take these into consideration.

Described below are the set of primary functions that are involved during the act of leisure drinking in a space bar. The relationship between these programs are being explained by the diagram below. This is followed by an analysis table listing all the related programs in relation to the bar operation.

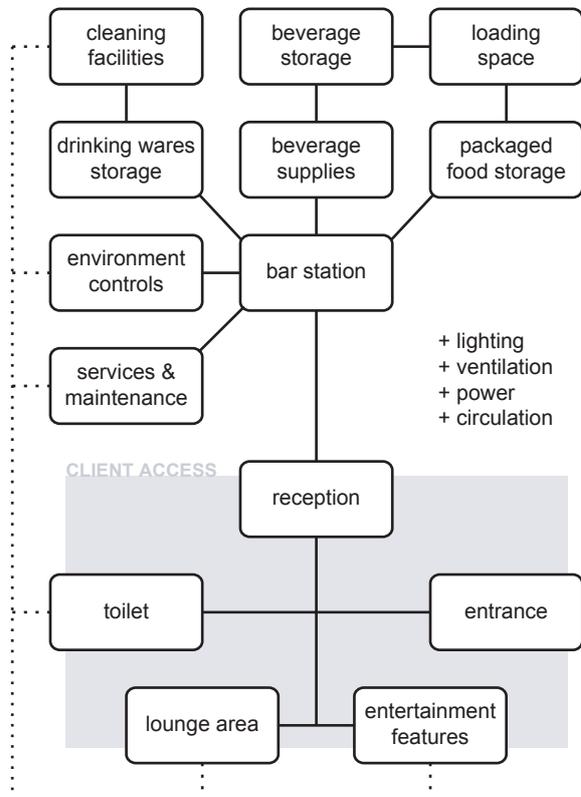


Fig. 1: relationship diagram for functions of a “space bar”

### Bar Station

The work station to perform drink preparation, and to provide interfaces between reception and various production programs.

If the bar is attended by staff, anchors, straps and other object securing systems are required instead of conventional long worktops.

### Reception

The primary interface between the clients and the bar where drinks are served. It may also act as the “frontage” of the bar, where clients could make their orders and wait to be attended to.

Anchors, straps and other object securing system are required instead of the conventional serving counter.

### Lounge Area

The designated area for the clients to settle down, with a primary aim of providing a relaxing atmosphere for leisure drinking. It is also the ideal spot for clients to socialise with friends.

The coffee table and sofas would be replaced by anchoring and strapping systems which would prevent oneself, as well as the beverages, “drifting away” from a specific location.

### Entertainment Features

These include features such as Earth observation windows, lighting installations and other value-adding facilities such as music and movies etc.

### Toilet

Self explanatory, and it must be taken into consideration for the planning of any bar design. It is likely to be a shared program with other habitable modules.

### Entrance

Distinctive threshold into leisure orientated space, also to contain the activity and its impact to adjacent quarters (light and noise etc.)

Should this be part of the design, it is likely to be in the form of a hatch door for the specific space bar module.

### Drink supplies

The mechanism that delivers beverages from storage to the bar station for preparation (an analogue example would be a beer tap)

### Environment Controls

To provide adjustable environment options in relation to the bar (e.g. light, sounds, A/C etc.)

### Drink Storage

To provide a safe and secure storage for the beverages. It must provide adequate shock & shake protection for the launches.

### Drinking Wares Storage

To provide safe and secure storage for drinking wares. As the maximum number of clients to be catered for at one time is small, the storage may be used to keep personalised drinking wares instead similar to a private bar.

Since the conventional design of cups and glasses are obsolete due to the absence of gravity in space, alternative means of beverage consumption may not require any drinking wares at all. (see later section on Alternative means of beverage consumption)

### Cleaning Facilities

To sterilise drinking wares after used. It is likely to be a UV or heat based sterilisation system.

### Packaged Meal Storage

To provide safe and secure food storage.

The issues related to food consumption in space is another major topic, of which this paper will not delve deep into.

### Loading Space

To provide working space for off loading and categorising supplies before assigning to designated programs.

In the following table, each of the programs were set against the criteria of whether they are sharable, adaptable and if they are considered critical to the space bar operation.

A program is considered “critical” if it cannot be deducted from the design without disabling the complete space bar operation.

A program is considered “sharable” if the same or similar functions could be found on existing hardware and could be utilised for the purpose of space bar operation

A program is considered “adaptable” if by adapting or adding minor modifications to existing hardware, the modified system could be utilised for the purpose of space bar operation.

	CRITICAL	SHARABLE	ADAPTABLE
Bar Station	YES	NO	NO
Reception	YES	NO	NO
Lounge Area	NO	NO	YES
Entertainment Features	NO	NO	YES
Toilet	NO	YES	NO
Entrance	NO	NO	NO
Environment Controls	NO	YES	NO
Services & Maintenance	NO	YES	NO
Drink Supplies	YES	NO	NO
Drink Storage	YES	NO	NO
Drinking Wares Storage	NO	NO	NO
Cleaning Facilities	NO	NO	NO
Packaged Food Storage	NO	YES	NO
Loading Space	NO	YES	NO

Table 1: analytical studies of functions for a “space bar”

### Alternative Means of Drinking

Another critical factor that would affect the design of a space bar is how the microgravity environment affect the means of beverage consumption. The absence of gravity in space effectively rendered all open liquid container obsolete. While the existing mean of drinking from sealed cartridge used by the astronauts are designed to satisfy the basic need of fluid consumption, it does not engage with other human senses such as vision, smell, sound and feel, all of which contribute to

the drinking experience. Therefore it is important for the design of space bar to take this into account, so that the proposed means of beverage consumption could positively enhance the overall drinking experience.

List below are some possible options for alternative means of drinking in microgravity condition:

#### Dedicated Drinking Vessel

A transparent vessel that is designed for both drink preparation as well as consumption. The vessels would be fitted with valves so that drinks can be pumped directly into the vessel and mixed within its chamber. A separate, smaller valve would be used to drink from. Further design possibilities may include vessels being made of inflatable materials and design.

#### Prefabricated Drink Tablets

A selection of edible, non-dissolving membranes or casings, infused with various beverages, either as liquid (similar to how the soup is stored within Chinese soup dumplings), or contained within a medium as a solid state (similar to a Volka infused water melon).

The tablet system would be easy to store and manage and it would eliminate the need for additional drinking wares. Drink tablets can be prepared prior to launch, hence less requirements for on site drink preparation.

The tablets can be manufactured with textured casings, made in transparent or tinted with colours, and infused with various fragrant smells.

They can also be made into various shapes that could provide additional entertainment (e.g. tablets can be made into the shape of chess pieces)

#### “The Drinking Room”

Clients dressed into waterproof gears could enter a designated area of enclosed space where blobs of beverages can be produced and are allowed to float freely within the enclosure, giving the most “genuine” drinking experience in space. Clients can either drink from the blobs of beverages with straws, or simply swallow them as a whole. Eliminating the need of additional drinking wares.

The drinking exercise can be modified to become a game on its own (e.g. trying to swallow all the blobs before they hit the wall...)

## The Drivers For Space Bar Design

There are three fundamental drivers for space bar design - safety, economy and client's desire.

The safety aspect has to be the single overriding factor that must be satisfied by any space bar design. Safety can be improved by pursuing better reliability and built in redundancies within the system, and good practices of risks management. In practice, this means the use of tried and tested systems is much easier and less costly to achieve the high standards of safety requirements. However, this does not mean that existing systems should always be preferred when compared to emerging technologies. Quite often better safety standards can be achieved by applying new thinking and technologies. In any case, the safer design is always the better of any design.

Considering the astronomical costs for such investment, the business model of the space bar is likely to have a significant influence over the design. A compact and lightweight design may be necessary in order to reduce the launching costs. Alternatively one could come up with a robust and sustainable design that allows for easy access for servicing and maintenance. The space bar design may have Earth-bound analogue options which maximises the reach of its potential markets. In brief, the economic factors will shape the general form of design.

Detailed design of a space bar would largely depend on the desires of its client, of what goal it is set to achieve. A design that aims to deliver the most comprehensive leisure drinking experience in space may not be suitable for a client who is only interested in being the first to deliver the experience with reliability. Therefore it is crucial at the beginning of the design process, to find out exactly what is the client's need.

## Possible Design Directions

There is no one way or "best practice" to the design of a space bar. As shown in various discussions above, the basis and emphasis of a space bar design is largely dependent on the combinations of various factors and criteria in relation to the realisation of the endeavour.

In this final section, the paper strives to give an outline of three possible design options based on three distinctive directions of anticipated client's needs and factors. The first design option has an emphasis on the practicability and reliability. The second option focuses on the economic and business aspects and with the third option being about delivering as much of a comprehensive experience as possible. These options are only intended to represent the stereotypical features of the extremes and by no mean exhaustive. A more realistic option is therefore likely to lie somewhere within the range set out by the three distinct design directions.

### Design Option 1: Adaptive Approach

The symbolic diagram below demonstrates the design features for an adaptive approach:

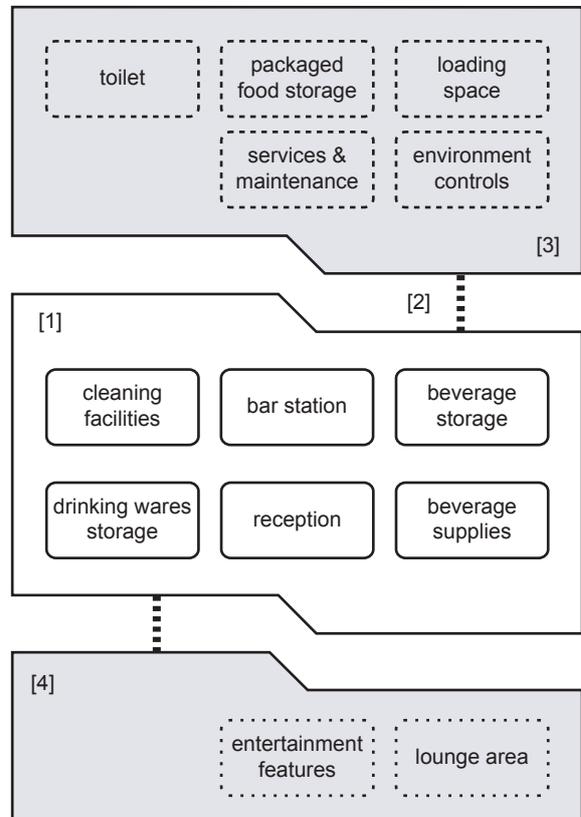


Fig. 2: an adaptive approach to space bar design

[1] All critical programs of the space bar are designed to be fitted within a framework that is compatible with existing systems and standards.

[2] Connections between space bar and existing hardware are all carried out through established standards and interfaces.

[3] Non critical programs of space bar are shared with existing hardware. Services and maintenances as well as environmental controls are based on the global systems

[4] Existing hardware are to be modified and adapted to perform additional functions in relation to space bar operations.

Pros and Cons

- + relatively less R&D/re-engineering/flight tests & certifications involved
- + quickest to be realised
- + design as a self contained system – less impact to adjacent hardware systems
- + employ tried and tested technologies and mechanisms only – less risks
  
- design which begins with inherent constraints and compromises tends to produce solution that is more about satisfying requirements than fulfilling the client's needs
  
- low marketability – difficult to sell it as an innovation. Conforming to existing standards also reduces its chance to be marketed as a fashionable product or as a trend icon.
  
- low versatility – decision to adapt a new design based on an existing standards run the risk of quickly becoming obsolete – current spaceflight standards were not designed with space tourism in mind. It is inevitable that the existing standards will be substantially changed in light of the rapid developments of the space tourism industry.

**Design Option 2: Product Orientated Approach**

The adjacent symbolic diagram on the top right corner demonstrates the design features for a product orientated approach:

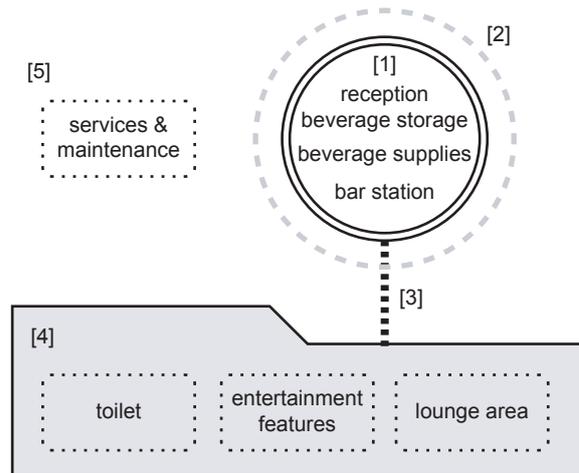


Fig. 3: a product orientated approach to space bar design

[1] Critical programs of the space bar are integrated and fitted within a very compact core, with an emphasis of achieving portable size and weight.

[2] With the exterior cover being separated from the internal core, it can afford a large degree of freedom and flexibility to the possible design form. It can also support high quality and customizable finishes.

[3] non-critical connections to existing hardware can be made for additional supplies and service possibilities.

[4] non critical programs are either omitted or rely on sharing and adapting facilities used by existing hardware

[5] the space bar design is intended to be carryable and to be serviced and maintained on ground.

Pros and Cons

- + self contained unit, design to operate as an individual product, or plug into existing hardware for expanded capacity if desired
- + portable and deployable, with a primary design goal to perform as a space bar
- + design for ground services and maintenance
- + easily recognisable, good potential to be marketed as a fashionable product / trend icon
- + “earthbound” version and other franchise / branded version of the space bar can be developed to further increase its marketing potential.
- + innovative and genuinely new design – easier to attract investments
- + very versatile – product can be easily updated to conform to evolving standards

- anything new in space environment means expensive R&D as well as a long lead time
- the design is likely to involve new technologies and mechanisms – potential risks on reliability
- the portable size of the product limits the scope of its functions and capacity. As such the design is unlikely to bring a truly comprehensive leisure drinking experience to the client.

### **Design Option 3: “No Compromise” Approach**

The symbolic diagram below demonstrates the design features for a “no compromise” approach:

[1] A start from basics approach with an ultimate goal of delivering the most comprehensive leisure drinking experience in space with a all inclusive design. The design of the space is given the utmost importance (except to safety) and is preferred over cost.

[2] Existing hardware is modified in order to provide all necessary supports to enable the space bar design.

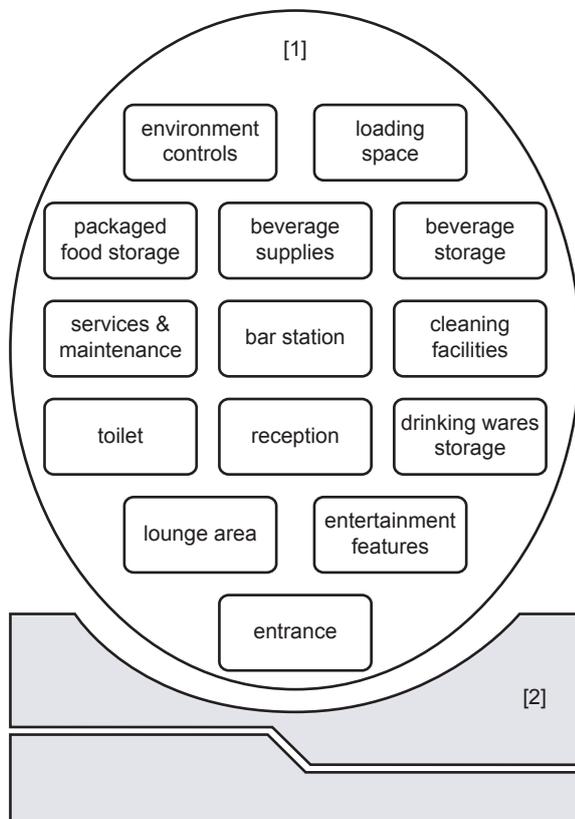


Fig. 4: a “no compromise” approach to space bar design

### **Pros and Cons**

- + design to deliver “the experience”, in full response to what the client really wants
- + the design is likely to be most akin to what the general public expect of a space bar – good marketing potential
- + the space bar is likely to be utilised for other leisure purposes, making it a multi-functional space entertainment room
- + legacy and privileges associated with being the first to deliver this truly leisure orientated facility into space
- Major design impacts to other spaceflight hardware and systems that may be difficult and expensive to resolve, it is also unlikely to be retro-fit onto existing system.
- design from sketches in space industry usually means very long lead time, extremely expensive, and a very high risk option as an investment
- the design is likely to involve many new ideas, technologies and mechanisms that may bring too much risks with regards to reliability
- low versatility – the installations are permanent and are difficult to change once the space bar is completed. However, some customizable options can be “design-in” to retain some degree of flexibility in anticipation of future modifications
- service and maintenance can only be done on site and is likely to be complex in nature. The space bar may also require additional personnel for it to perform to its full potential .

### **Conclusion**

A space bar is a design that is dedicated to the purpose of leisure drinking. The concept would only become feasible when all of the prerequisite criteria have been satisfied.

There is no single design solution that can be considered superior to another, since much of the details depend on the combinations of factors and criteria which would be unique to each client. However, a good understanding of the effect of microgravity has on the space bar operation, as well as consideration regarding all the primary drivers for a space bar design are necessary in order to achieve an informed design that would satisfy the client’s needs.

### **References**

1. “The Architect’s Plan of Work”, Roland Philips, RIBA publishing June 2000