

Luminous ambience design

Navigation and reasoning by photographic images for formulation of intentions

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Key words: Luminous ambience, Design, Reasoning, References, Navigation, intentions formulation

Abstract: In order to assist daylight ambience design by referential procedures, we propose in this article an analysis of the modalities of reference activity in the field of architectural design. We have identified three different activities: selecting a potential reference, projection of the reference in the project, integration of the reference into the project, allowing intentions formulation. We have used the results of this analysis to propose navigation modes adapted to an exploitation of image references in design, in order to develop a tool supporting the formulation of luminous ambience intention. The purpose here is to inform on exploratory progress more than to communicate attested results.

1. INTRODUCTION

Daylight is one of the essential elements contributing to the quality of building interior ambiances (Millet, 1996). Experience shows that taking daylight ambience into account needs to be approached in early design when the first draft of a building is examined. During this phase, the designer searches to formalise one or several intentions describing the luminous ambience inside spaces to be conceived.

To define a luminous ambience, we refer to the definition made by Narboni who characterize a luminous ambience as “the result of an interaction between a light, a space, and a use”. This interaction influences the perception and the feel of the illuminated space (Narboni, 2006). We

thus speak about daylight ambience when it answers at least these three interactions (*Figure 1.*):

- daylight–use: identify a requirement for quantity and quality of daylight;
- daylight-space: define daylight effects;
- space-use: inform about architectural devices to be implemented.

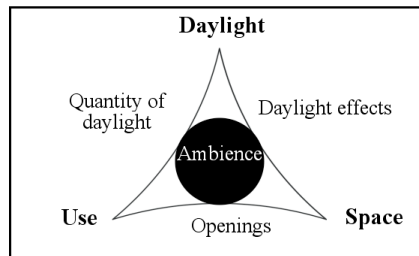


Figure 1. Daylight ambience

In many programs of architectural projects, we don't find any information or requirements about ambiances to be conceived. But when they exist, they focus on requirements relating to the useful amount of daylight in relation to the program and it is necessary to verify it at the end of the project.

This quantitative information is necessary, but not sufficient when the need is to conceive creative ambiances. So, it is up to the architect to imagine and describe the daylight ambience to be designed.

Therefore, to enhance their creativity, designers use heuristic method among which we find referential procedures and in particular visual image references. Many books written to educate young designers urge the use of visual references. For example (Antoniades, 1992; McKim, 1980) point out the importance of learning by studying visual references.

Architectural designers use the term "references" to mean objects that inform their designs. Visual images, taken as reference, can play a key role in supporting the emergence of ideas and solutions in project situation by combining ideas from different images or by expanding the search space by retrieving and adapting previously stored designs.

Concretely, a visual image taken as reference allows the designer to express or refine his ambience intention without having to describe it precisely: "I would like my space to be illuminated like the chapel at Ronchamp". Image reference can also contain some concrete and useful answer elements for the definition of the project: "in a chapel, zenithal lighting oriented to the east brings soft morning light".

Thus, during the early stages, when the designer is looking for relevant

ideas to employ, the use of reference images can be a crucial help.

On the basis of this hypothesis, we propose to assist daylight ambience design with a reference management system that allows the designer, at the creation stage, to find potential references allowing him to formulate his intentions and to take into account the phenomena of luminous ambience from the first stage of design.

In our research, we chose a particular type of visual reference: the photographic image. The image is interpreted from a visual point of view and can become active agent in producing design ideas or solutions (Marda, 1997). The architect is going to transpose these ideas or solutions into his own architectural production after having extracted their essence. Analogy appears to be the most frequent procedure in this transfer of knowledge (Casakin, 2004).

The first part of this article addresses the modalities of the reference activity by tracing the exploitation process of image references in design and by identifying the different reasoning modes implemented. The second part consists of defining the various modes of navigation which will allow the designer to find potential references.

At the end of the article, we will determine the relationship between modes of thinking and modes of navigation that we will implement in our tool supporting luminous ambience design.

2. MODALITIES OF REFERENCE ACTIVITY

The analogy, as main procedure in a process of reference activity, is defined as a transfer of knowledge from source elements (known and familiar) to target elements (to be conceived). In other words, it helps to explain new problems by means of resolute ones. Architects often use visual analogies during design development. Examples can be found in the works of famous architects, such as Le Corbusier (Pauly, 1980), Calatrava (Jodidio, 2007).

The visual references used by architectural designers can belong to a multitude of domains and not only to the architectural one. We distinguish between “within domain” and “between domain” analogies (Casakin, 2004). In “between domain” analogy, the visual reference belongs to a domain different from architecture and conveys distinct information in correlation with structural or formal aspects. (*Cf. Figure 2.*)



Figure 2. S.Calatrava, Planetarium, Science museum and l'umbracle, Spain

When the image reference belongs to the architectural domain, the analogy is then called "within domain". In this case reference images illustrate architectural projects having raised a particular design problem. Therefore, we make the hypothesis that the information generated by these references can be more easily integrated into the design process, we deliberately limit the field of our investigation to only images illustrating architectural works. Then, how can knowledge contained in these references be integrated into the design?

The process of the exploitation of image references in design activity is rather complex. Our interest concerns particularly the characterization of the various operations solicited during the use of references. In this context, Le Corbusier says about the use of references: "to look and to see, by distinguishing carefully to look which is simply to note, to collect, to gather in, and to see which is already to understand, to generate reports, or to classify; then only invent and create"¹ (Pauly, 1980).

The examination of this quotation enabled us to identify four activities operated by a designer in a reference work (*Figure 3.*). These activities are not necessarily expressed by the designer, but show a progress of the use of references. Starting from these activities, we have identified four different stages: *selection* of a potential reference, *projection* of the reference in project being designed, *integration* of the reference into the project and *formulation of intentions*.

¹ In the original context: « Regarder et voir, en distinguant soigneusement entre regarder qui est simplement noter, recueillir, engranger, et voir qui est déjà comprendre, dégager des rapports, ou classer ; ensuite seulement inventer et créer» (Pauly, 1980).

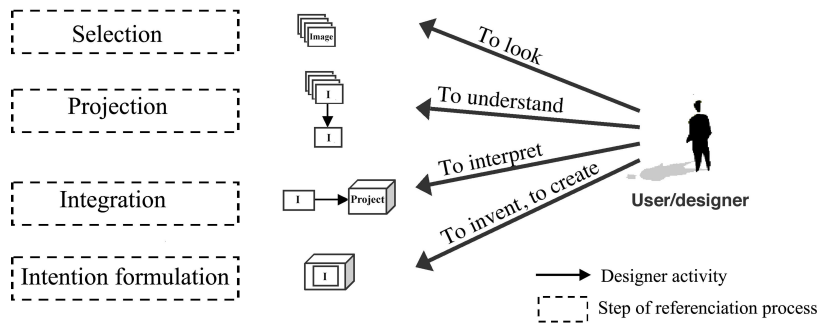


Figure 3. Reference work process: activities and steps

2.1 Selection of a potential image reference

The selection of one or several potential references is the first step in a reference activity. The experience and the perceptive capacity of a designer are important factors which will enable him to locate points of interest in the reference and to find correspondences if they exist between the reference and his project being designed.

2.2 Projection of the reference in project

The projection of a reference in a project is correlated with the understanding of its content.

How do architects project the information they “borrowed” from references in their design? We can identify at least two major types of referential actions those concerning formal analogies and those concerning procedural analogies:

- Formal analogy or « perceptual similarity » (Do and Gross, 1995) : as when a shape represented in a reference reminds the emerging shape in the new design. For example, Le Corbusier had used a formal analogy in “the chapel at Ronchamp”. He had determined the shape of the gargoyles by a scaling of the shape of the “Barrage de Chastang” (Figure 4.). In the field of ambience design, a formal analogy can be established with the shape of openings.

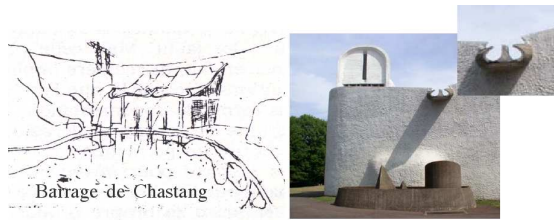


Figure 4. Le Corbusier, The chapel at Ronchamp

- Procedural analogy: in this case, the designer tries to identify the process implemented in the design of the represented project giving him ideas or solutions for his design. For example in the “Institut du Monde Arabe” in Paris, Jean Nouvel chose as references the Moucharabieh pattern and the light-controlling diaphragm in a camera. By procedural analogy with these references, he formulated his intention about sun shading. The result is a giant Islamic pierced screen that gives audacious luminous ambience to the building (Figure 5).

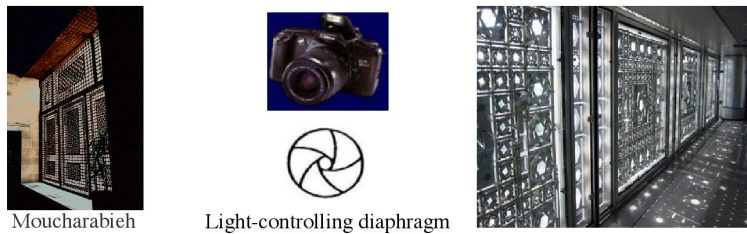


Figure 5. Jean Nouvel, Institut du monde arabe, Paris, 1987

These two referential actions, formal analogy and procedural analogy, allow the architect to find ideas or solutions which must to be interpreted and adapted to be integrated into the project being designed.

2.3 Integration of the reference into the project

A deeper understanding of the content of an image reference supports its creative integration in the process of resolution and formalisation of ambience intentions. For that purpose, the designer tries to formulate one or several hypotheses. Their formulation is generally associated to other types of reasoning: abduction and deduction. These types of reasoning characterize other forms of knowledge construction. Concerning reasoning with images we can speak about abductive analogy and deductive analogy.

The search for hypotheses of design on the basis of past experiences can be seen as a sort of abductive analogy in the way where we try to collect from precedent projects represented in images, the parameters, the constraints and the methods of probable solutions in response to a project's need (Guéna, 1993). Thus, the abductive analogy can be seen as a cognitive activity that serves the discovery. The designer can make surmises about creative conceptual solutions to improve and develop his design. "L'institut du monde arabe" is an example of the use of an abductive analogy (*Figure 5*).

For the deductive analogy, we have a cognitive activity which allows to forge a solution from observations or a set of hypothetical variables and constraints. A deductive analogy enables the designer to implement and to concretize his hypotheses.

So, an abductive analogy allows expressing the content of a problem well formulated, so that a deductive analogy can be used.

Take back the example of "l'Institut du Monde Arabe", we speculate that the designer had guessed the configuration of "Islamic pierced screen" with a deductive analogy. He might have deduced a procedure concerning for example the size, arrangement and repetition of openings.

2.4 Formulation of intentions

The formulation of the intentions is not necessarily the last stage of a reference work process. These intentions are formalized throughout this process. We mention it as the last stage because it is the expected result.

The act of drawing in architecture is an act of thinking, a creative act of ideas (Marda, 1997) but also a tool to experiment ideas and intentions (Goldschmidt, 1994). Indeed, designers sketch, doodle and draw in order to understand and assimilate new knowledge. These forms of design representation provide also the opportunity to explore alternative hypotheses and to test new ideas in a visual form. We can therefore say that the act of drawing can be a helpful way to understand and transform references and can be a part of the process of reference work.

We can find such diagrams in the sketchbooks of famous architects such as Louis I. Kahn or Alvar Aalto (*Figure 6*).

Estevez (Estevez, on 2001) attributes three fundamental functions to the drawing:

- a prescriptive function which concerns to the physical construction of the building.
- a descriptive function allowing the control of the shaping and the appearance of the building through the figuration.
- a speculative function supporting the design activity.

It is this latter speculative function that interests us in our work of developing a tool to assist the formulation of ambience intentions.

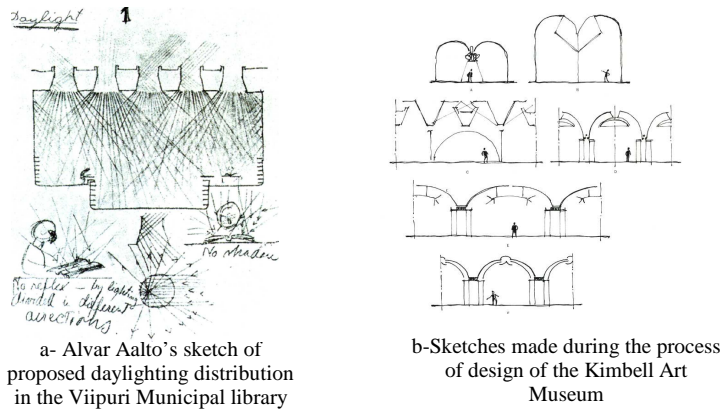


Figure 6. Sketches produced by masters of architecture

3. MODES OF NAVIGATION, MODES OF REASONING

Figure 7. shows the place of a tool, manipulating a collection of image references and with adapted modes of navigation, in the cognitive process of the formulation of intentions.

During a design creativity phase, the user/designer is going to search in a collection of images (navigation) one or several potential references. He observes (selection of a potential reference), reasons (projection of a reference), learn (integration of an image references) and formalise his ambience intention.

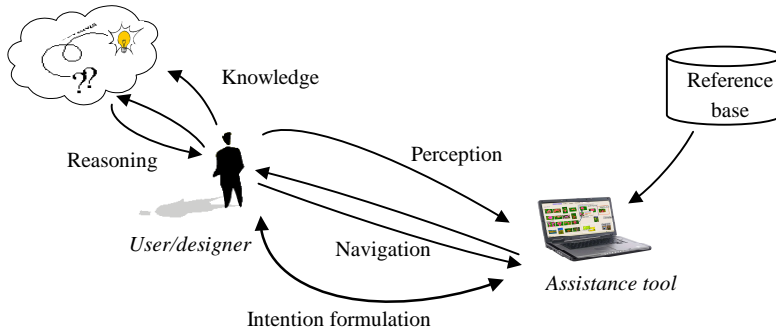


Figure 7. An assistance tool in a cognitive process of the formulation of intentions

Our preoccupation is to develop a tool supporting ambience design and taking into account the modalities of a reference activity. We aim to define navigation modes adapted to the various ways of reasoning defined previously.

A prospective study on systems that propose dynamic and non-sequential navigation methods in databases of images (Halin, et al, 2005; Veltkamp and Tanase, 2002) - although they are not all oriented to the assistance of architectural design - allowed us to examine several modes of navigation in order to identify those that can potentially favour the different operations of visual references exploitation and different modes of analogical reasoning described above.

We have identified two relevant modes of navigation, the mosaïc and the relational graph. Each navigation mode proposes a specific method of visualization and navigation stimulating different modes of reasoning. Following the analysis of these modes of navigation, we proposed the navigational compass, which can facilitate a better localization in the referential space.

3.1 Mosaïc

In a visualisation with a mosaïc form, the images, all the images have the same importance, are juxtaposed according to a regular framework (and sometimes imposed).

The system displays a first mosaïc of images randomly selected. The user can choose, reject or not give opinion for each image presented. The interactivity of this navigation, associated with a process of relevance feedback (Halin, et al, 1990) allow refining the research from the analysis of positive images (selected) and negative images (rejected), and then proposing a new mosaïc.

When the user makes a choice of positive images, we suppose that he has identified interesting points in these images, potential references. He can make surmises, and formulate some hypotheses about probable solutions for his project being designed. We develop here the hypothesis that this mosaïc navigation can support an abductive analogical activity and can also answer efficiently to the first stage: selection of potential references.

3.2 Relational graph

A relational graph visualizes a set of images related with arcs which materialize the semantic links existing between them. This mode of

navigation was adopted in the “Vizster”² interface which is an online social networks, allowing exploration of the community structure of social networking providing means by which users can publicly articulate their mutual “friendship” in the form of friendship links, forming a graph in which users are the nodes and friendship links are the edges.

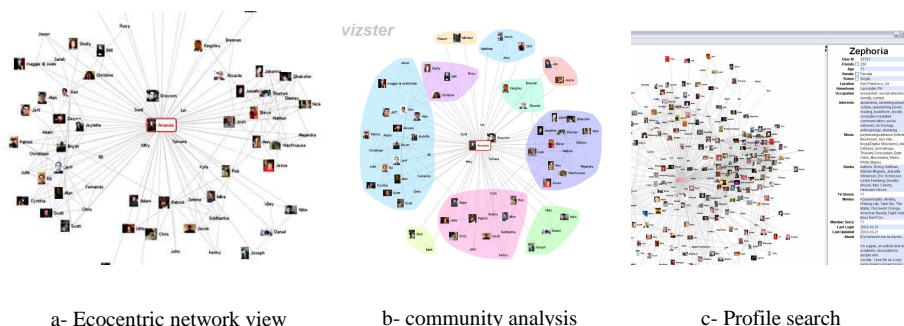


Figure 8. Vizster interface

The user of this interface can choose a “general network” view or an “ecocentric view”. The “ecocentric view” (*Figure 8a.*) shows the relationship between one person and other members of the community, providing information about this relationship.

He can also use another type of navigation, “community analysis”, which displays the member of each community in a group (*Figure 8b*). This navigation form combines two types of information, relations between member and the community they belong to. In “profile search”, the selection of a word or a text in profiles (*Figure 8c*), makes respective members active. This allows the user to find members or also common points between members of the community.

In our case, the nodes are the images and an arc connecting two images materializes the semantic similarity between them. Indeed, each image of our corpus is indexed textually from a thesaurus constructed on the basis of luminous ambiances (Chaabouni, et al, 2007). The semantic similarity between two images is calculated on the basis of this indexation.

The obtained graph allows the user to navigate through the images, by selecting a node and deploying the nodes (similar images) linked to this one.

What is important in this mode of navigation in comparison with the mosaïc mode, is that the semantic relations between the similar images are visible. In this case, the user has a better understanding of the content of the images, and can more easily make deductions of type “cause and effect” or of form “A is to B as C is to D” for facilitating deductive analogies. This

² <http://jheer.org/vizster/>

mode of navigation can support the process of the projection of a reference in a project.

3.3 The navigational compass

The navigational compass is a functionality to be combined with the two modes of navigation presented previously. It allows, by restricting the field of the query, a more precise localization in the referential space.

The navigation compass consists of five vertexes connected with ten arcs. Each of these vertexes represents a semantic domain of the thesaurus from which images were indexed (*Figure 9*). The navigation in this navigational compass is done using a cursor. Several positions are possible:

- Vertexes: while placing the cursor on one of the five vertexes, the system searches for similar images according to the domain related to the selected vertex.
- Arcs: while placing the cursor on one of the arcs, the search for similar images is guided according to the two domains forming the vertexes of the arcs.

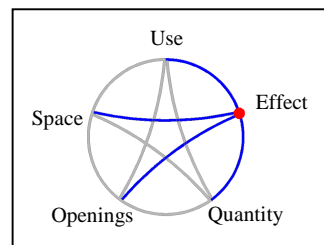


Figure 9. The navigational compass

Concretely, when the user/designer is searching for potential references, he wants, for example, to find images that represent different daylight effects in order to design an ambience with a particular or creative effect. In this case, starting a mosaic navigation from the navigational compass enables him to go more quickly towards the references which could be relevant.

Or, when the user/designer has already located a potential reference, he can continue his navigation by a graph mode. When the graph is visualized, the user/designer can navigate in the navigational compass and choose different positions. For each position, the system will show similar images, related to the selected image, according to one (cursor placed in a vertex) or two domains (cursor placed in an arc) of the thesaurus.

The goal of all these modes of navigation by searching and interpreting references is obviously the formalisation of intentions.

3.4 Formulation of intentions

We showed previously that the drawing is a part of the process of reference exploitation in design activity. So, it is necessary to give the user the possibility to draw and to integrate his references into his drawings in order to allow the formulation of intentions. Therefore, we think that it is interesting to integrate a zone for freehand expressions into the tool we project to realize. In this zone, the user/designer can:

- draw one or several sketches,
- import images selected during the process of navigation to complete the information contained in his drawn sketch; resize the imported image; choose all or a part of this image,
- annotate his sketch; add comments and text.

This zone can be accessible throughout the navigation activity. For every project, the user/designer can produce several sheets of drawings. He can therefore constitute his own sketchbook. This book can be consulted at any time during the process.

4. FUNCTIONS OF THE TOOL AND THEIR ROLE IN AN AMBIANCE DESIGN PROCESS

From the analysis made in this article, we were able to precise (*Figure 10.*) relations between modes of navigation and modes of reasoning in the reference activity and thus refine the role of an assistance tool in this activity.

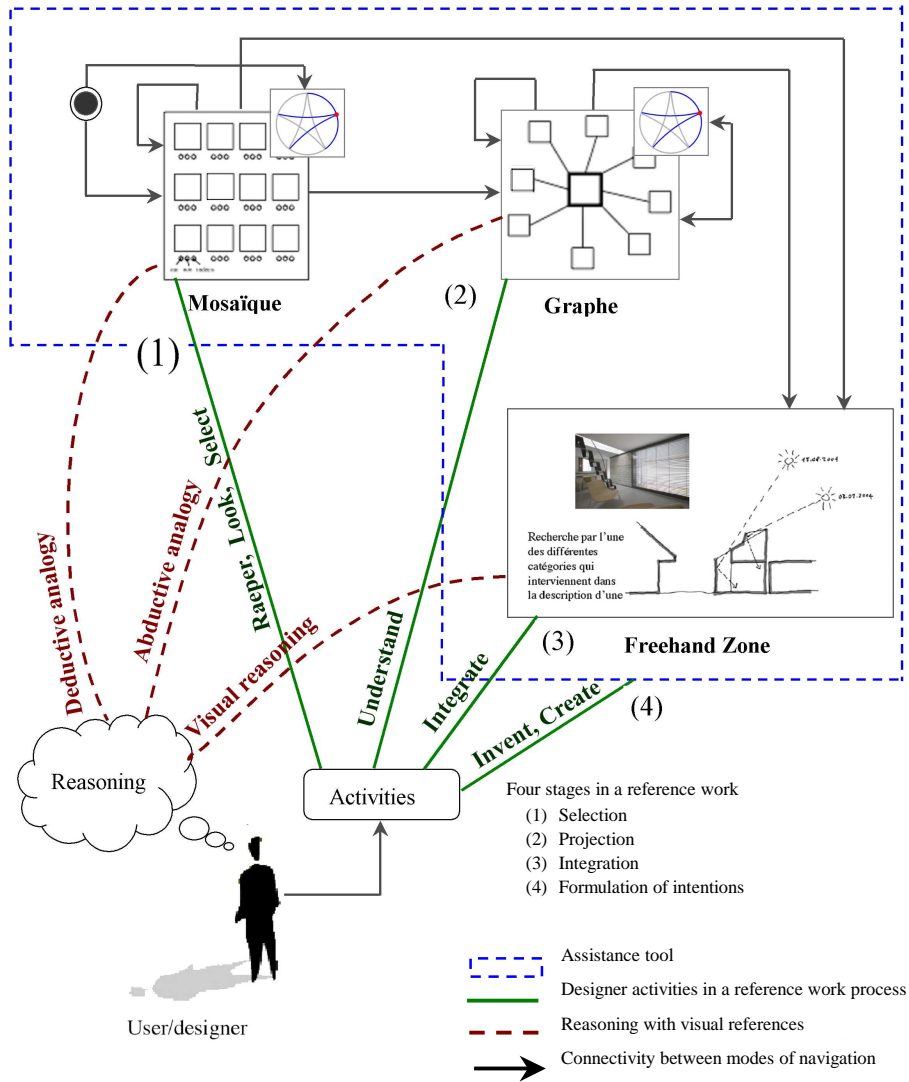


Figure 10. Functions of the tool and their role in an ambience design process

5. CONCLUSION AND FUTURE WORK

Supporting ambience design during initial phases of architectural design is possible with referential procedures. This article, shows the role of image references in the design activity, and analyzes the process of exploitation of

these references. Four stages were identified: *selection of* a potential reference, *projection* of the reference in project being designed, *integration* of the reference into the project, *formulation of intentions*.

The analysis of the exploitation process of image references allowed us to specify the forms of analogical reasoning used in order to propose better adapted modes of navigation to be implemented in a luminous ambience assistance tool. Three forms of navigation have been presented: the image mosaïc, the relational image graph and the navigational compass in the reference space. A “freehand zone”, where the user/designer can express his hypotheses by visual means and formulate his intentions, supplements these navigation modes.

In order to validate the hypotheses studied in this article, we plan to develop a prototype of the tool integrating the functions of navigation and intention formulation defined here in order to conduct an experiment validating the hypotheses formulated about the adequacy of the modes of navigation with the forms of reasoning solicited in the referential activity

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