ABSTRACT
Some buildings are designed to provide light, others are designed to be experienced in light. The paper will focus on the latter, by observing examples of the relationships between architecture and daylight beginning from the built form, especially from the building’s envelope, its thickness and permeability.

The study is divided –synthetically–into six essential strategies.
Structural form channeling light / New materials, or architecture’s adoption of technologies from other domains / Conventional materials used in innovative ways / Materials forced into unusual casings or thicknesses / Poor materials lifted up into a new dignity / Superimposed veils.

Keywords: Building envelope, Daylight, Project strategies

1. INTRODUCTION
A building’s skin has the capacity to bring about osmosis between inside and outside. By enclosing with walls and roofs, from infinite external space the architect abstracts a finite, defined space, which has characteristics of light and shade according to the choices made in the very act of enclosure. Spaces that are identical in terms of walls, floor and dimensions can be indeed differentiated by different strategies for handling natural light: a bright light coming from behind the wings will throw the wall that conceals it into sharp relief; a substantial light brought in via an overhead oculus will highlight the floor; a soft, diffuse light will render the space generous and unified. And we should not forget that the introduction and control of daylight is not only achieved by means of openings in walls, but also via turrets, shafts and roof lights, which are themselves components of the building envelope. Also, light can be admitted by openings other than windows - disjointed surfaces, gaps between walls and discontinuity of walls and ceilings.

2.1 Structural form channeling light
We can talk of design applications where space is ‘managed’ by light. In the first place, there is architecture in which the very structural form of the building is formulated around this objective.
Consider the section which informs the Bregenz museum, where the design of the floors as superimposed ‘trays’ allows Peter Zumthor to create a diffuse, overhead luminosity on every level of the building. Consider also the baths
at Vals (Fig.1) where with a different type of materiality Zumthor creates a new structural balance, with intriguing light effects. Internal rigid angled frames allow the roofs over different rooms to cantilever and become detached in space. The resultant slots allow the sun to flood in over the thin stones, permeating the rooms with a silent intimacy. Toyo Ito’s parallel experiments offer a different interpretation of the expansive and dynamic quality of light. In the structural innovation of the Sendai Mediatèque, visibly distended columns offer the key to generating powerful funnels of light. The entire volume is pierced by them, from the roof to the ground, and the spaces assume an ambivalent quality, between technological and biomorphic, with interlaced transparencies and perspectives. Ito fully engages with the design possibilities created by computer technology, working immediately in 3D to explore new alternatives to the traditional column:slab relationship. An analogous study led him to design, for the Tods building in Tokyo, a façade of superimposed branches which allowed him to move away from the traditional wall:window relationship.

2.2 New materials, or architecture’s adoption of technologies from other domains

Another interesting area of research concerns the use of new building materials, or rather architecture’s adoption of technologies which traditionally belong to other domains.

In his Menil Museum in Houston, Renzo Piano adopted a construction which derives from the world of naval architecture: ferro-cement ‘leaves’ gather and screen the top light to the galleries, controlling diurnal variations in light. The stone gabions used by Herzog and De Meuron to guarantee cooling and shade in the Dominus winery in Napa Valley, California, derive from the world of hydo-engineering; the result is a veil-like
façade, which creates a constantly changing speckled light internally, mutating according to the degree of granulation of the gabions. Jean Nouvel's sophisticated application of a superimposed photo-sensitive screen at the Institute of the Arab world in Paris derives from the world of optics; the constantly changing irises operate in response to the sun – precision instruments reinterpreting archetypal elements of secular Islamic architecture. An innovative use of materials, with surprising results, was adopted by Jun Aoki in the Louis Vuitton Ginza building in Tokyo (Fig.2). A glass fibre reinforced cement façade has integral white alabaster inserts, of varying sizes and arranged in an apparently casual manner. During the day the building is alive with subtle variations in opacity. At night, it twinkles with mysterious luminescence. In the same city, Kengo Kuma experiments with the qualities of plastic in the Nakameguro house, using it to form walls, stairs, enclosures. The plastic material allows daylight to permeate the spaces discretely, re-interpreting the traditional Japanese house’s attention, through modern technology.

2.3 Conventional materials used in innovative ways
Aligned to these experiments, but more closely connected to tradition, are envelopes which use conventional materials in innovative ways.
Firstly, take marble, capable of the most delicate transparency. Franz Füeg’s Meggen Church, in Switzerland, refers back to the tradition of religious architecture. Within an aesthetically neutral volume a thin slab of pentelic marble is given the task of allowing this religious space to be permeated with an occluded light that is drenched in colour and which has an almost palpable consistency of glowing golden tones. In a different context but with an effect that is no less sacred, is the poignant wall created by Alberto Campo Baeza in the Caja General de Ahorros in Granada (Fig.3), surmounted by a commanding roof light. All the golden declivities of the alabaster are liberated by the natural light from above and the artificial light from the offices behind. In the striking dimensions of the internal courtyard, a high wall of alabaster slabs spreads its own transparency over an extraordinary area, brought back down to human scale by small windows on each level, in clear glass. Entering into this provocatively disproportionate volume, one fully appreciates Baeza’s pairing of the words ‘Light’ and ‘Gravity’. Another bank design which uses alabaster is the Deutsche Bundesbank in Chemnitz, Germany, by MAP with Josep Lluís Mateo. Here the result is very different. Rather than a warm, golden light, a pallid white light is released into the spaces by the skies of Northern Germany. This reminds us how the surfaces themselves are merely elements of manipulation of light and that the quality of light is never fixed, but is subject to the nuances of geography.

2.4 Materials forced into unusual casings or thicknesses
Other design experiments are dedicated to shaping or forcing materials into unusual casings or thicknesses. Herzog and De Meuron have given us many hugely creative examples, starting with the inventive progressive inclination of the thin copper louvres which clad the signal box at Basel station. This simple technique creates an unexpected play of shadows on the envelope, and entertaining visual aberrations of the volume inside which seems to twist and stretch along with the louvres. The stainless steel cladding of the later Barcelona Forum (Fig.4) is worked as well in a simple way that produces unexpected results. Strongly reflective polished triangular panels are arranged so as to be faceted in space and are then embossed with a wave-like topography. Daylight penetrates right down to the ground.
through shafts which penetrate the roof. As it passes across the distorted panels the light is refracted, broken up and multiplied, bringing with it exuberant and dazzling reflections of which it is hard to determine the origins. In contrast, architects’ experimentation with glass has been more restrained. Take the main façade of Rem Koolhaas’s Casa da Musica in Porto, where glass is curved in deep and regular undulations, assuming a considerable, almost volumetric depth. Consider the façade of the Dior Building in Omotesando, Tokyo, where SANAA have experimented with moulded acrylic to make it assume a three-dimensional consistency, with varying cylindrical profiles. Light and views pass through the transparent envelope but are slightly distorted by it and appear as feeble apparitions in space. Decidedly more ‘inscrutable’ is the façade of Rafael Moneo’s San Sebastian Cultural Centre, wrapped in its double skin of heavy glass vanes, where the outer skin is formed of long, striated concave troughs. The unusual thickness of the envelope and the varying opacity of the glass give the building a dense but luminous corporeality and the dilated interiors are given a sumptuous elegance by the generous light; by night, the two blocks are transformed into powerful lanterns by the sea’s edge.

2.5 Poor materials lifted up into a new dignity

A number of recent studies on the theme of the luminescent volume have in common innovative uses of ‘poor’ materials, to give them a new dignity. In particular, profile polycarbonate has been elevated from its former role in making temporary metropolitan shelters, to enclose more sophisticated spaces, on a par with the more noble glass. It is no surprise that this option has been taken up enthusiastically in Japan, with its traditional preoccupation with thin screens and delicate balance between light and shade, as mentioned previously. Opaque or translucent, stand-alone or in composite panels, profiled polycarbonate sheets are replacing the traditional shoji in the noted ‘S’ and ‘M’ houses by SANAA, cocooning their occupants in discrete, opalescent lanterns. In different countries, polycar-
bonate has become a common material for the enclosure of simple three-dimensional blocks, or for more articulated volumes, such as Ábalos and Herreros’s Gordillo studio in Madrid. Indefatigable proponents of the facade, Herzog and De Meuron have turned this exercise into virtuosity, bathing polycarbonate in colour: the cellular polycarbonate sheets cladding London’s Laban Centre (Fig.5) incorporate delicate tones of pink, lilac, pale yellow and green. The double skin, of generous proportions, has polycarbonate as the outer layer and opaline glass as the inner one. Simply arranged according to a continuous colour gradation, the external sheets transfer their own yellows, pinks and greens through the white opaline glass filter, which mingles and merges them as they pass through, revealing new delicate tonal results on the inner glass. The dancers can concentrate on their work in a cocoon, with no distractions, immersed in the most delicate vibrations of colour.

2.6 Superimposed veils

In order to illustrate less substantial envelopes, modelled and formed by light and shade, we must turn to the concept of the ‘veil’, formed by lightweight superimposed meshes or by real screens built of substantial materials such as stone or concrete.

Take Tadao Ando’s Festival Building in Hokinawa (Fig.6), with its porous wall made of hollow concrete blocks, through which the sun is projected to form a sort of continuously changing solar ‘clock’ on the walls. Very much more recently, Tuñon and Mansilla created a similar effect in their Madrid swimming pool, with its long concrete panels with interstitial slots. Kengo Kuma assembles thin volcanic stone slabs in his Nasu Stone Museum in Japan; the size and the method of assembly of the modules are varied according to their location in the building. Numerous regular slots interrupt the fabric, sometimes covered by opaline panels of Carrara marble, making the wall pervious to light. The theme of opening the house to the landscape whilst protecting it with a veil recurs often, throughout the world. Sean Godsell’s Peninsular House, Australia, Baumshlager + Eberle’s Lochan House in Austria, with its lath screens, or von Gerkan’s Alvaro House in Hamburg, with its CorTen grille. Other examples are the staggered screens of Carme Pinos’s Cube Tower in Guadalajara, Mexico, or Daniel Bonilla’s interesting approach in the Milagrosa Chapel in Colombia, where an entire screen of timber louvres rolls aside. Finally, the fritting on a glass façade can appear as a screen without depth; whilst still performing its function of a filter for sunlight and a modulator of delicate shadows in the internal spaces. From Norman Foster’s early use of abstract opalescent gradations at Stockley Park, near Heathrow, through Herzog and de Meuron’s provocative graphics on their Ricola factory, to Wiel Arets’s more restrained decorations at Utrecht, fritting of the façade has become a formal design tool, on a par with the more independent elements form which a building’s envelope is constitutive.

3. CONCLUSIONS: NOT ONLY FAÇADES

Up to this point I have been concerned with some of the many lines of research into light and the envelope, using examples which concentrate on the actual consistency of the envelope, its thickness and permeability. However, there are many and widespread completed examples that derive from the more traditional skills of the architect: spatial articulation through conscious choices of plan form and, more importantly, section, to channel daylight deep into a building; the use of light funnels, perfected in every detail to transport light and focus it precisely; the manipulation of
surfaces in order to determine its imprint. These are trends which are well reflected throughout history – from the sacred hypogeum, to the temple, and the cathedral. In the less distant past, the great masters – Aalto, le Corbusier and Kahn, to name but three – transformed the mundane into the magnificent through the sublime manipulation of light. Without doubt, these past trends were the conscious inspiration for the emotive roof lanterns of Carlos Ferrater’s Barcelona conference centre, the pools of coloured light in Steven Holl’s St. Ignatius Chapel in Washington (Fig.7) and the dissolution between the floor and walls of Ando’s Naoshima Chichu Art Museum (Fig.8).

And then there is also the Word. The Word of the architect, written or imparted by many of the above mentioned personalities, who speak of architecture and light using the voice of man rather than creator, of poet rather than designer, and which are transmitted to us through feeling rather than sight. There are too many words to be engaged with, recalled and enjoyed than there is space for here – words that would convince us that to design with light is really to create machines à émouvoir.