IMPROVING BUILDING VALUE THROUGH FACADE WEATHERPROOFING

1.0 – Intro

A - Improving Building Value

Creating a building is one of the most demanding challenges that we as an individual or the company for which we work can undertake, and the major goal of all the players is to create the most valuable building with the available resources, within budget, and on time.

At the same time, buildings are a major part of our lives. We spend most of our lives inside buildings: we work inside of buildings and perform the majority of our non-work related activities inside of buildings. If we aspire to do these activities in comfort, healthily, safely and using the minimum possible resources, we must create comfortable, healthy, safe and sustainable buildings.
How the building performs with regards to all these considerations defines building value.

During the last years a lot has been done with regards to green building, but it is now clear that the market needs to focus and ally sustainability on its different dimensions (environmental, economic, social and cultural) with human health and wellbeing. In this way we may transform our buildings, and as a result our city's, for the benefit not only of the people living within, but for the planet as a whole. Taking a holistic approach to construction can only add value to a project

"We shape our buildings
and afterwards our buildings shape us" *(1)*

B - Buildings – A giant puzzle in our cities

Buildings are comprised of a giant puzzle of different, individual components and materials. We must look at the whole building as an integrated structure. But we must also look deeply into each of building individual components and materials in order to achieve the ideal final solution, and so improving building's value.

C - Facades – The impact on building value

Building envelope, and particularly facades, plays a crucial role on how the building performs during its life time and on how it addresses the above mentioned goals. Facades will greatly influence the value of a building as they determine:

- Aesthetics
- Protection against water and moisture
- Thermal efficiency
- Acoustic performance
- Natural lighting
- Indoor Air Quality
- Wind loads
- Durability

"The façade is the filter between the climate outside and the conditioned space inside, it determines the appearance of the building and its performance" (2)

The goal of this document is to support the market players and stakeholders on understanding how we can improve building value through façade weatherproofing.

Every building project has a unique set of program goals and technical requirements that should determine the façade waterproofing design. At the same time today's market evolves more quickly than ever. It is essential to understand not only which are the state of the art solutions but also on how can these solutions facilitate the fulfilment of project requirements and add value to the final product.

"Technological progress and industrialization of the construction industry means that the role is changing from controlling the design through a profound knowledge of materials and techniques, to a role of orchestration of a multitude of specialists skills, knowledge, and industry intelligence" (3)

(1) Health, Wellbeing & Productivity in Offices – The next chapter for green building

(2) Façade Engineering & The Design Teams of the Future

(3) Façade Engineering & The Design Teams of the Future

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1.1 Improving building value by sealing façade connections

A - The Building Enclosure - Weatherproofing

In our introduction we have briefly analyzed the importance of a building's façade and its impact on a building's global performance and final value.

A building's façade is the filter between the climate outside and the conditioned space inside and as such it has to address / control multiple loads and functions. Focusing only on climate related loadings, a building, and its enclosure, experience different conditions or microclimates, depending on the project's location, landscape, adjacent buildings, façade and roof configuration, among others. This microclimate has to be taken into consideration when designing a façade solution.

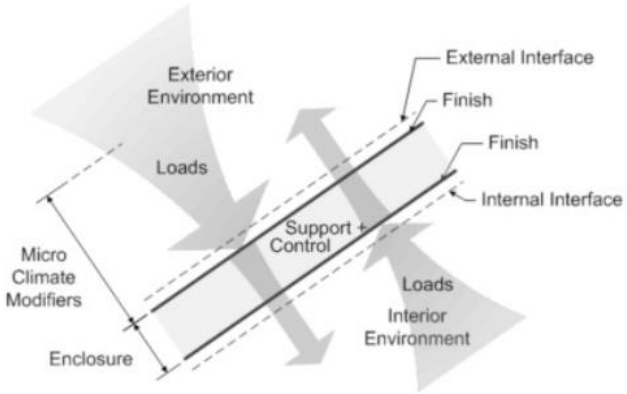

Fig. 1 Building enclosure and its functions *(1)*

The performance of a façade should be analyzed taking into consideration how it behaves in relation to the different loadings generated by the exterior environment, the interior environment, and the building enclosure itself.
There is a complete list of climate related loadings (2) that a façade needs to address, such us:

- Solar light
- Heat
- Water
- Air
- Moisture

In this Ebook we will focus on façade weatherproofing but more in particular on the control of water, air and moisture, ensuring watertightness, airtightness and moisture management in facades.

B - Controlling water, vapour and moisture on facades

- Controlling water ensuring watertightness

Protection against water penetration is, since the very beginning, a major function of a building's envelope. However, water leakages remain one of the most common building pathologies, and are definitely, one of those that most deeply affect the performance of our buildings and their value. Water leakages can almost instantaneously cause deterioration of the most common construction materials, uncomfortable indoor environment, and in worst cases, affect a building's structural stability by, for example, causing corrosion on metal structures.

- Controlling air and moisture ensuring airtightness and moisture management

With major efforts made initially in Europe and North America, airtightness (3) has now globally become a standard requirement for a building's envelope, with major efforts made recently by Australia and Canada, among other countries. It is essential to work towards energy consumption efficiency (energy consumption reductions reached trough airtightness can reach up to 40%), maximizing thermal and acoustic insulation, and eliminating the risk of mold (4) and other building pathologies associated with moisture (5).
Moisture management is strictly associated with airtightness, and every building airtightness analysis has to consider facade moisture management, assuring that the designed solution eliminates the risk of condensations and allows the evaporation of internal existing or generated moisture.

(1) http://buildingscience.com/documents/digests/bsd-018-the-building-enclosure_revised

(2) http://buildingscience.com/documents/digests/bsd-018-the-building-enclosure_revised- Please check fig. 1, 2 and 3

(3) http://rdh.com/wp-content/uploads/2014/04/Air-Leakage-Control-in-Multi-Unit-Residential-Buildings.pdf

(4) https://www.wbdg.org/resources/moisturedynamics.php

(5) https://www.wbdg.org/resources/moisturemanagement.php

C - Façade connections - The most common leakage paths

The number one rule to ensure a building's enclosure watertightness and airtightness, is to ensure the continuity of the water and air control layer.
However, a building's enclosure and in this case, specifically facades, are a combination of planar components, and each of these components is a three-dimensional, multi-layer ensemble that extends from the inside to the outside.
While it may be easier to define the watertight and airtight solutions for these planer components, usually the bigger challenges arise at the connection areas of these planar components, or at points where these planar components need to be perforated or penetrated by the passage, or fixation, of singular construction elements.

These interfacing areas are the most common façade water and air leakage paths. Compromising the quality of a sealing solution for these areas means compromising the façade's complete watertightness and airtightness.

D - Sealing Façade Connections

Sealing façade interfaces such us the connections between, windows or doors, and the cladding wall, is usually a challenge.
These are areas where the convergence of very different materials, with very different properties and behaviors, happens, such as metal and concrete, or steel and plaster. These are also the areas where the larger facade movements have to be absorbed and where the selected construction materials are under bigger stresses or loads.
Meanwhile, these are areas that are not so expressive, volume wise, on a façade's complete packaging, and many times, properly designing the solution for these connections is not faced as a priority.

(1) http://buildingscience.com/documents/digests/bsd-018-the-building-enclosure_revised

(2) http://buildingscience.com/documents/digests/bsd-018-the-building-enclosure_revised - Please check fig. 1, 2 and 3

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1.1 Improving building value by sealing façade connections

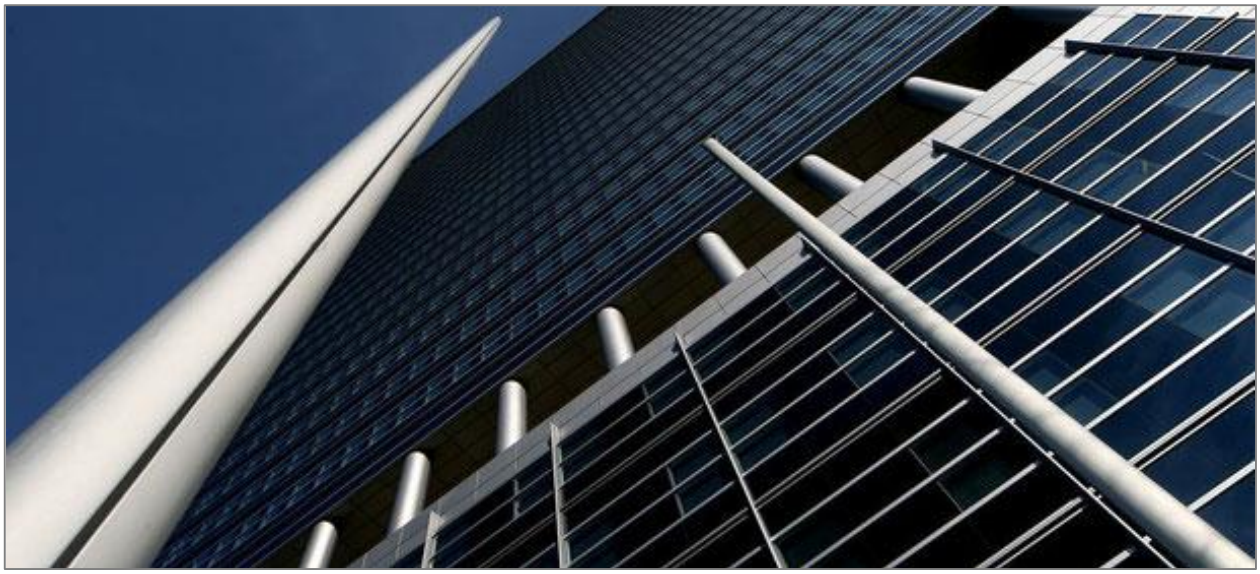

Photo Source: http://www.wolfgangjaeckle-foto.de/architektur/

1.2 – Sealing façade connections – Raising the standards: state-of-the-art solutions

A – Façades - As good as its weakest points

A manufacturer designs its solutions detailing the interfaces between its system components, however the interfaces between different manufacturer's components and on-site constructed elements, such as concrete walls, are under responsibility of the specialized contractor only. Common difficulties arise when the work of two contractors converge.

The materials used on joint sealing are minor components of the building envelope and often contribute with the lowest percentage of a project's overall cost. However it is common sense that a façade will only be as good as its weakest points, which almost always happen to be its interfaces or joints.

Despite the above mentioned, joinery of façade components is, in most cases, not closely analyzed until the later stages of project designing and also not completely discussed until on-site installation comes up. At this point the standard solution will, many times, be fitted to all details. As a result, water leakages and other pathologies will appear as early as 1 or 2 years after the project's conclusion.

It is essential to carefully detail all building's joints and their sealing solutions at an early stage.

"How the façade elements join should be considered early in the design phase" *(1)*

B – Building joints: Classification (2)

Joints are made to join together elements of the building and may be used for two purposes:

- **Fixed joints**

These occur where materials are joined because maximum panel or unit sizes require the use of more than one element. Joints also occur where different materials or components meet.
At a fixed joint the adjacent components are fastened together to prevent movement between them. The joint then has a constant size and shape and the sealant does not have to move significantly.

- **Movement joints**

These joints are created to allow the building and its cladding to move. Movement occurs because of temperature changes, wind loading and imposed loading, amongst other causes.
Movement joints are made at the natural joints in the building where there would otherwise be fixed joints.
The shape and size of a movement joint will change daily and over longer periods of time. A sealant that can move in the required way is chosen for a movement joint and there is a wide range of performance available.

C - Designing joints and joints' sealing solutions

1 – Identify where joints occur through the façade

Once general façade design is defined and main façade materials are selected, the designer should summary all the materials' interfaces occurring on the façade, as well as consult manufacturers to determine minimum number of expansion joints and their sizes, vertically and horizontally.

2 - Identify the different types of joints

All the identified joints should be grouped up into types of joints. Similar joints, with similar requirements, should be considered as a single type of joint, where an identical joint sealing solution can be used.
This will give an idea of how many different details will be needed to document the different joint designs.

3 – Determine the complete requirements for each joint type

For each type of joint it is necessary to determine the amount of movement that it needs to accommodate (movement joints), as well as all other joint requirements and special conditions.

4 – Select joint sealing material

Considering the requirements identified on stage 3, it is now possible to select the best solution for each joint type, and to develop all necessary design details as well as solution specifications and installation guidelines.

Accepting that there is no such thing as an “ideal sealant”, helps one to accept that it is strictly necessary to take into deep consideration all the joint requirements and particular features, in order to select the best sealing solution for each joint type.

D - Selecting a joint sealing solution

Criteria that should be analyzed for selection:

- **Project characteristics**
  - Expected durability (service life time)
  - Expected movement
  - Joint geometry
  - Substrates - Compatibility and adhesion
  - Service environment (temperature, water, UV, acid rain, pollution)
  - Special applications (potable water or food service applications)
- **Performance**
  - Resistance to chemicals (ex: oil, fuel, hydraulic fluids, cleaning chemicals)
  - Resistance to biodegradation
  - Vandalism resistance
  - Loading resistance (pedestrian or wheeled vehicles)
  - Puncture, tear and abrasion resistance
  - Fire resistance
  - Maintenance requirements
- **Installation**
  - Installation environment (space limitations, weather restrictions, etc.)
  - Ease and speed of installation
  - Level of labor specialization
  - Error possibility
  - Waste management
- **Aesthetical concerns**
  - Color and color retention
  - Possibility of painting
- **Environmental concerns**
  - VOC’s content
  - % of recycled and recyclable materials
  - Waste

Only when all solution performance requirements, for any identified joint group, are listed, considering the above criteria or others that might be relevant, it is possible to select the best joint sealing solution and develop the necessary project details. The “ideal” solution will completely depend on this analysis.

For small joints, with small movements, liquid sealants may be acceptable, but depending on the façade system, gaskets, rubber membranes or other customized solutions may be more effective. Technical support from manufacturers is key during every stage: joint sealing solution selection, specification and installation.

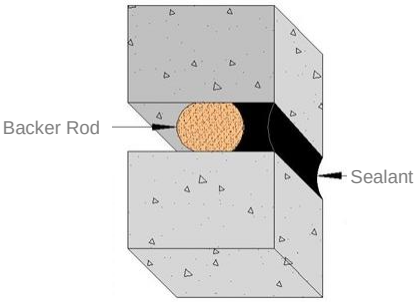

Fig. 1 Standard sealing detail with sealant and backer rod

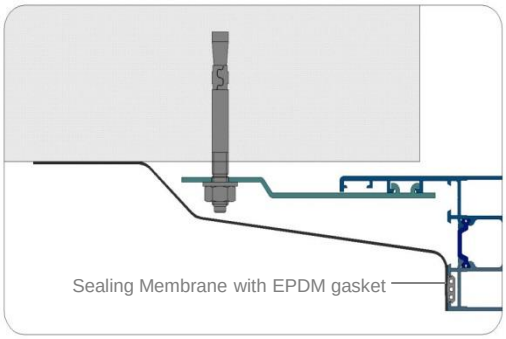

Fig. 2 Sealing membrane with clip-in gasket

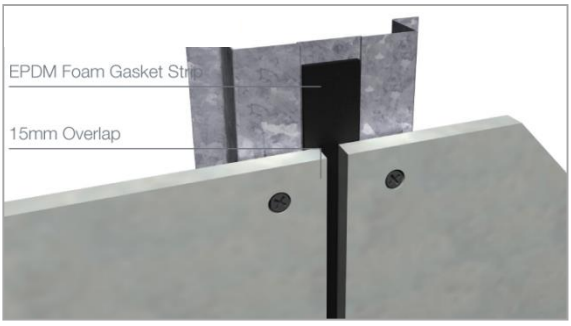

Fig. 3 Sealing detail with foam gasket strip

(1) http://www.rci-online.org/interface/2010-BES-maing.pdf

(2) http://www.cwct.co.uk/construction/installation%20guide/INST-ALL.pdf#page=17