

# APPENDIX: TECHNOLOGIES FOR ACCESSIBILITY

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Nowadays, to analyse accessibility in construction would be absolutely impossible without referring to the development and consistent application of so called “new technologies”, which offer the possibilities to improve the mobility in urban and building environments and the capacity to use these environments. In fact, these technological advances lead to new achievements in personal autonomy (automation of processes in urban spaces and public buildings as well as in private homes<sup>1</sup>, progressive advances of informational society<sup>2</sup>, etc.) and the problems that still require solutions are the stimuli for further research.

## A.1-Types of technologies related to accessibility

The field of technologies related to accessibility is so extensive and have so many input variables that any classification results difficult. The technological achievements are the product of progressive development in a wide spectrum of industries and disciplines, which embraces architectural components, urban fixtures and construction materials as well as medicine and rehabilitation. They also result from innovations in informatics, electronics and domotics.

In order to analyse the present level of development of technologies related to accessibility and obtaining major degree of autonomy for people with disabilities, it is proposed to make classification basing on three fundamental questions described bellow.

### A.1.1- What Human Activity Technology Facilitates

As it was said in the chapter I “Building accessibility analyses” (see 1.1 – Activity components), with respect to accessibility all human activities have two components: mobility and use. Therefore technologies can be divided into two functions:

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<sup>1</sup> J. Roca (UPCT – the Polytechnic University of Cartagena) y E. Del Campo (UNED - the State University for Distance Education), already in 2002, were predicting in their article *La accesibilidad total: un nuevo concepto en la superación de barreras* (“Total accessibility: a new concept of overcoming architectural barriers”): Building automation, in particular, that of residential buildings, is expected in the nearest future to occupy an important place in sphere of integration and personal self-sufficiency of disabled and elderly people, in a wide range of functional disabilities, both physical and cognitive.

<sup>2</sup> Joan Majo, a university professor and Minister for Industry and Energy in the first government of Felipe Gonzalez, already in 1997, sustained: The transformation of industrial society to informational one entails important social changes. A prototype of industrial society is a production chain that suggests a physical working place to which employees displace at a certain hour. In informational society the idea of “time and space” is substituted by a possibility to perform various tasks from home and within a flexible schedule. This change expands the possibilities of disabled eliminating the rigidity of time and physical space.

- IMPROVING MOBILITY; technologies that improve the capacity of person to move faster, with major safety and efficiency.
- FACILITATING USE; those that make easier the course of everyday life activities in a variety of environments: at home, school, work or at leisure.

### **A.1.2- How Technology Works**

Present technological development shows how, in some cases, devices designed to compensate a lack of functionality of certain parts of body (or just to gain in comfort) make a course of activity easier and, in others, allow some substitutive action. From this angle, technologies can be divided into two groups:

- PASSIVE technologies, which improve possibilities to use certain environments without substituting human action, such as non-slip pavements for ramps, walking prostheses, Braille writing system, lever-type door handles or single lever bathroom taps.
- ACTIVE technologies, which act on behalf of a person. This group includes spacious elevators, electric wheelchairs, automatic doors or sensor taps.

It is necessary to combine both “types” of technologies in order to improve environmental accessibility. Some construction professionals may ask: wouldn't it be better, instead of adapting urban and building environments for use of people with disabilities, to develop wheelchairs able to climb stairs? The answer seems clear: both things should be done. As the improvements in vehicle design (cars, trains, etc.) go in parallel with the improvements in infrastructures (motorways, railways, etc.), the progress in accessibility is built on active technologies as well as on passive ones.

### **A.1.3- How Technology Relates to Construction**

Building construction is a complex process that involves the participation of multiple parties. The final quality of a building is a result of harmonic combination of various elements, such as thermal and acoustic comfort, safety, illumination, communication possibilities, etc., perceived as “natural” condition of an environment. For example, if in a room designed as a studio, the table is positioned in such a way that the natural light does not produce dazzle nor shadows on its working surface; if electric and telephone sockets are found somewhere near the table and not at the other end of the room; if the radiator is situated under the window where cold enters from and not in the corridor, so that the room gets heated uniformly; if the walls and the ceiling are isolated acoustically so that no disturbance could be produced by the neighbour's TV or crying babies, then the user would feel comfortable.

That is why, from the point of view of the parties involved in construction and with respect to construction process, it is convenient to make a distinction between “associated” technologies and “autonomous” ones:

- ASSOCIATED technologies are those incorporated in constructed element. They form part of the design and construction processes.
- AUTONOMOUS technologies are those brought by the user.

“Associated” technologies, therefore, should be taken into consideration throughout all the processes of conception, development and completion of a building or any other constructed environment.

### A.1.4- Summary

The combination of three described variables gives place to eight different groups, or “types”, of technologies, which can be seen in the following scheme:

<b>Technologies for Accessibility</b>		
<b>For What Type of Activity</b>	<b>How Technology Acts</b>	<b>Relation to Construction</b>
<b>Mobility improving</b>	Passive	Associated
		Autonomous
	Active	Associated
		Autonomous
<b>Use facilitating</b>	Passive	Associated
		Autonomous
	Active	Associated
		Autonomous

## A.2- Prototype examples and development

Present technological development is very uneven. Some of technologies are widely established while the others are still at an incipient level. There are also great differences regarding costs, reliability, continuity expectations, existence in the market, standardisation and normalisation, etc.

That is why it is worth describing some prototype examples to illustrate each group of technologies mentioned, to evaluate the level of their present application (regulated and in practice) and to find out which entity corresponds to their further development.

## A.2.1- Passive technologies associated with construction elements

### A.2.1.1- Mobility improving

The technologies related to mobility are specified when planning access routes to buildings and urban environments.

This group of technologies, no doubt, is among the most developed and legally regulated ones, and their origin lays in continuous claims for accessibility. They were also the first interventions made to eliminate architectural barriers and to promote designs with no such barriers.

The task to plan accessible routes when constructing a new building or adapting an existing one corresponds, basically, to the designer. But even though these interventions belong to the design process, the common application of norms regulating the needs for accessibility, allowed the development of such methodologies, systems and products that constitute the technological support of great value. (Fig. 1, 2, 3 and 4/ Fig.5 and 6).



Fig. 1, 2, 3 and 4. There was big progress in the last few years in resolving pedestrian and vehicle crossings with standardised accessibility elements. The examples shown above represent kerb elements for driveways, 20, 40 and 60 cm wide (depending on the height and the width of the walkway) that do not interrupt the continuity of the walkway; and kerb elements for pedestrian way, 120 cm wide that include a trash bin and a traffic lights post as elements of

delimitation of walkway and protection of the lateral level change. These kerb elements also incorporate central guide strip to direct vision-impaired people; the material used is non-slip and easy to maintain (granite with bush hammered finish) and special pieces are available to solve curves.



Fig.5 and 6. Another complex problem is to solve the limits between a pavement and a space around tree trunks. The examples of tree grates shown above allow the correct growth of the tree; concrete slabs that limit the tree well are easy to adapt to a walkway pavement and concentric cast-iron rings are resistant and non-deformable.

### A.2.1.2- Use facilitating

This is a case when solutions adapted by the designer (for example, a substitution of a shower plate by a non-slip pavement with incorporated drainage) match with those offered by the manufacturers of construction elements (single lever bathroom taps, non-slip pavements, etc.).

In our opinion, the development (design and manufacturing) of such technologies corresponds to industry, while the application (to choose the right element for the right place) is the task of the designer. In the recent years there has been an important increase in an offer of elements that improve accessibility, such as lever-type door handles and taps, electric mechanisms easy to handle and with a wide range of colours, bathroom accessories that improve safety, etc. (Fig. 7 and 8). However, some important problems still need solutions, for example, to find a type of pavement that would remain non-slip when moist and at the same time easy to clean.

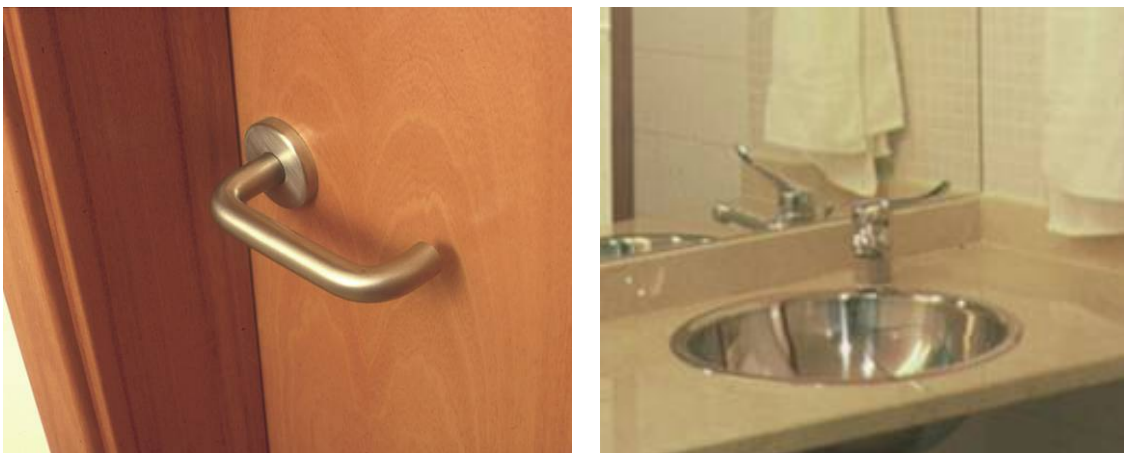


Fig. 7 and 8. Most of manufacturers offer in their catalogues products that are easy to manage.





Fig. 9 and 10. It is easy to find non-slip pavement to pave a bathroom; the problem is to clean it. Very rough pavements tend to accumulate dirt particles that are difficult to eliminate, while double-floors retain humidity and give place to the spread of bacteria.

## A.2.2- Active technologies associated with construction elements

### A.2.2.1- Mobility improving

The most representative example would be an elevator, as it offers for all kinds of users a safe and reliable way to move, and as such ideally suited for vertical displacements. (Fig. 11 and 12). For existing buildings, platform stairlifts may be the solution, while moving walks, ramps and escalators have their major application in buildings and urban areas with heavy pedestrian traffic. (Fig. 13 and 14).



Fig. 11 and 12. The correct use of an elevator allows solving complex situations. This building that lacks space at the street level, gains access to the attic and semi-basement by a double-door elevator.



Fig. 13 y 14

The building transportation industry, with its long tradition and wide coverage, is the one to which corresponds to develop technologies to increase the level of accessibility within buildings. In fact, there are many existing technologies developed in this field (microlevelling, Braille button panels, acoustic information, doors that open automatically, etc.), but their use presently is not really extended. On the other hand, as all mentioned elements are to be installed in constructed environments and buildings, the construction industry has to take in consideration all those aspects of infrastructure that would allow an installation of the technology in question.

### **A.2.2.2- Use facilitating**

These are technologies that make so called “intelligent building”. Although some of them are well developed and have reasonable reliability (automatic doors, motorized blinds, sensor taps, thermostats for heating systems, etc.) (fig. 15, 16 and 17), and though accessibility provisions are becoming incorporated in machinery of everyday use to automate certain processes (cashpoints, ticket dispensers, POS card machines, etc.), the fact is that we are still just at the beginning of more global and integrate process. It is also important to remember that technologies of this type require significant maintenance and have to evolve into more reliable and economic solutions that would allow their generalisation and wider application in domestic environments.

It is therefore necessary to promote R+D processes that would put together the contributions of the electronic and communication industries with those coming from the field of construction.



Fig. 15, 16, 17 and 18. There is a number of reliable and easy to install systems to open doors automatically; the sensor-type taps are accessible and save water. Some cashpoints have keyboards with instructions in Braille and concave buttons that facilitate the use for those who have difficulty with fine motor skills.

## A.2.3- Passive autonomous technologies

### A.2.3.1- Mobility improving

This group of technologies includes all types of prostheses that help to move, wheelchairs, rolling walkers, etc. Its development is linked to the fields of rehabilitation medicine and industrial biomechanics. (Fig. 19, 20, 21 and 22).



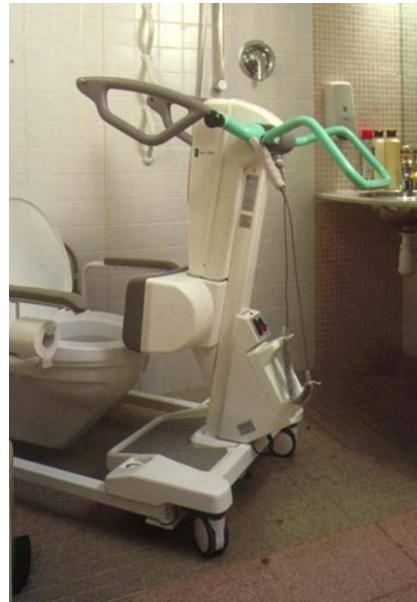
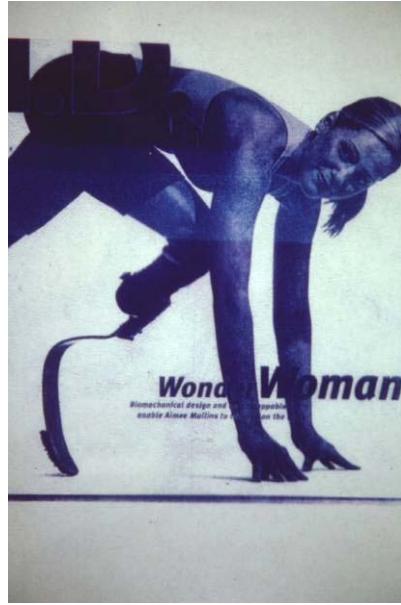
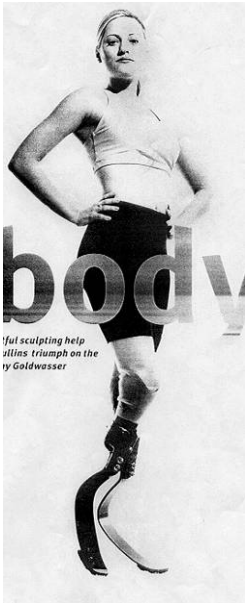


Fig. 19, 20, 21 and 22. The range of products is very wide: from the simple rolling walkers and traditional wheelchairs to the sophisticated prostheses adapted for sport practise and to the special cranes that can transport people in vertical position.

### A.2.3.2- Use facilitating

These are, basically, so called “assistive technologies” (fig. 23, 24, 25 and 26), which presently are mainly linked to the field of rehabilitation and occupational therapy. This group of technologies has been practically unexploited in our country until now and it is crucial to awaken interest of industrial design specialists.



Fig. 23, 24, 25 and 26. Increasingly wider spectrum of products is brought into the market to facilitate daily activities. However, these products often lack desirable quality and reliability.

## A.2.4- Active autonomous technologies

### A.2.4.1- Mobility improving

The most developed item representing this group is an electric wheelchair, available in a range of modalities and with variable particular features (fig. 27). The model that stands out is the recently commercialised “Explorer” that can be described as a wheelchair that goes up and down stairs and negotiates other obstacles with ease and autonomy (fig. 28).





Fig. 27 and 28. An electric wheelchair is good for levelled surfaces only, while “Explorer” allows climbing stairs.

On the other hand, it is worth mentioning numerous contributions made by the automotive industry to facilitate driving (automatic transmission, power-assisted steering, power brakes, etc.), to improve general accessibility characteristics (reclining and folding seats and those that can rotate around an axis; introduction of sliding doors in small cars, etc.) (fig. 29 and 30) and to introduce special adaptations (controls that allow driving without using legs or just with one hand). A prototype of an accessible car, par excellence, would be the “fantastic car” that appears in some science fiction films and is completely automated, including the very process of driving.



Fig. 29 and 30. This model of “Raum” from Toyota incorporates some interesting accessibility features in a mass-production vehicle.

It would be necessary to promote R+D programmes that would merge the autonomy needs of different kinds of users with the possibilities that offer the automotive and transportation industries.

#### **A.2.4.2- Use facilitating**

Although many traditional electrical appliances increasingly incorporate functions that facilitate use for people with disabilities (fig. 31 y 32), an idealised

prototype for this group of technologies would be a “robot” that performs all the work on behalf of the person that cannot move (fig. 33), or a “reading device” that transforms visual information into other sense modalities for the sightless person (fig. 34), or a “translator” that converts sounds into visual images for the hearing-impaired person.



Fig. 31 and 32. This washing machine has an inclined loading door, to avoid bending down; and big buttons with large font and Braille indications to facilitate understanding for users with different needs.



Fig. 33 and 34. “Asimo” is an experimental robot-prototype with humanoid appearance. Computer keyboard with a Braille bar represents a very useful adjustment for vision-impaired people.

It would be convenient to introduce accessibility criteria in R+D programmes related to automation of processes and at the same time to launch special programmes to make existing technologies more approachable.



## A.2.5- Summary scheme

To sum up all the mentioned above, technologies for accessibility can be represented in eight groups in relation to three given variables.

1. What activity technology facilitates: distinguishing between MOBILITY and USE.
2. How technology acts: PASSIVE and ACTIVE technologies.
3. How technology relates to construction: distinguishing between technologies ASSOCIATED to construction process and AUTONOMOUS ones.

<b>Technologies for accessibility</b>				
<b>For What Type of Activity</b>	<b>How Technology Acts</b>	<b>Relation to Construction</b>	<b>Prototype Example</b>	<b>Development</b>
Mobility improving	Passive	Associated	Design without architectural barriers	Designer
		Autonomous	Prosthesis	Rehabilitation + Industrial Biomechanics
	Active	Associated	Elevator Platform stairlift Ramp/ escalator	Construction/ Building Transportation Industry
		Autonomous	“Explorer” Electric wheel chair “fantastic car”	R+D in Transportation and Personal Autonomy
Use facilitating	Passive	Associated	One lever tap Non-slip pavement No-plate shower	Designer + Industry of Construction Elements
		Autonomous	Assistive technologies	Occupational Therapy + Industrial Design
	Active	Associated	Intelligent building	R+D in Construction and Communication
		Autonomous	Robot	R+D in Engineering and Communication

This scheme summarises prototype examples to illustrate each group of technologies mentioned, and points out which entity corresponds to their development.

Finally, it has to be mentioned, that traditionally, among technologies related to construction, those that improve mobility get more developed than those that

improve the possibilities to use the environment, and within each group, passive technologies prevail over active ones. In other words, the possibility to enter to a building is considered before the possibility to work (or act) inside it, probably because if the first is not possible, the latter has no sense. The ramp (passive technology) till now has been considered ideally suited for the vertical displacement in opposition to the elevator, perhaps because the latter requires major maintenance and has little possibilities to keep operative in emergency situations. In order to illustrate this situation, the colour code has been used, indicating in dark blue and red technologies that show respectively high and low degree of development (or application) and reserving light blue for those situated in intermediate position.

As a conclusion, we would say that technological progress offers great possibilities for improving autonomy of people with disabilities. It is therefore very important to loose no opportunity to incorporate accessibility criteria in all R+D+I programmes.