New material and techniques for Plumbing and its Maintenance

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Abstract: Quality of materials, technology, installation procedures usually come second to luxury finishing. Rapid technological progress over the last few years in materials and technology used in the construction of water distribution systems has caused a great deal of suspicion amongst designers. On the other hand, in the choice of the piping system cost is nearly always the most important factor. Hence this work refers to the review of the plumbing systems materials and future scope. Standards are sets of rules that outline specification of dimensions, design of operation, materials and performance, or describe quality of materials, products or systems. These standards should cover the performance expectations of the product for particular applications, as well as, in the case of drinking-water contact, the chemicals that may be leached from the product into the water. The intent of standards is to provide at least minimum quality, safety or performance specifications so as to ensure relatively uniform products and performance, and to remove ambiguity as to the suitability of certain commercial products for particular applications. In this paper we study the comparison of new material and old plumbing material with respect to strength cost and usage.

1. Introduction

Water distribution for human consumption has always been a cause for concern for the entire world, with every civilization looking to structure their development in close proximity to water.

Plumbing and drainage have been “the poor cousins” of construction in Portugal. This inferior treatment is explained, mainly, by the recurrent misunderstanding of the concept of “quality construction” with the concept of “luxury construction”. Quality of materials, technology, installation procedures usually come second to luxury finishing, this being more immediately and directly visible and therefore, more highly valued by the end user. However, if they are badly designed and built, these features become an enormous source of problems with which the user will have to deal with.

Rapid technological progress over the last few years in materials and technology used in the construction of water distribution systems has caused a great deal of suspicion amongst designers, builders and other technicians in relation to many of the solutions that, because of their apparent simplicity and rapid execution, were supposed to take the place of the so-called traditional materials and techniques. This suspicion is further strengthened by the introduction on the market from manufacturers of new tools and equipment used to apply their own joining techniques that guarantee complete leak-proof connections.

On the other hand, in the choice of the piping system cost is nearly always the most important factor. However, there are many other questions that have to be addressed, notably, the physical, chemical and biological features of the material, the temperature and pressure of the water, the accessibility of the network, the knowledge and experience of its users, its availability on the market and technical assistance.

The design of the piping systems for hot and cold water installations must meet the following purposes:

1. To ensure the water supply on a continuous basis with the adequate flow, under the ideal conditions of pressure and speed. It should guarantee proper functioning of the installed devices and the pipe system

2. To preserve the high level of water quality in the public supply systems

3. To promote water and energy conservation

4. To allow an easy maintenance during the functioning of the network

5. To provide high levels of comfort to the potential users

To ensure the compliance with the stated purposes, it is necessary that the system components can guarantee the best performance required. The
materials used for drinking and sanitary water piping networks play an important role in this subject.

The technological evolution of materials used for drinking and sanitary water piping networks, in recent years, has been enormous. The first supply networks have been performed on metallic materials. The piping networks in lead due to their easy workability were used for decades. However, the awareness of the risk of the intake of lead to human health, even in small doses, led to the ban of its installation in the water supply systems. The lead piping networks were followed by galvanized steel and copper ones, which allowed the installation of piping systems of higher pressure classes, and quickly became an alternative to networks in lead. In fact, these systems stand out for their leak-proof connections, mechanical resistance, dimensional stability and durability, however after some decades of use, the metallic corrosion effects were felt, creating problems both with water quality, as with functionality of the installations. To give an answer to the effects of corrosion appeared the stainless steel piping systems, whose price has increased considerably the total cost of piping systems.

The emergence of synthetic materials has revolutionized the market for water supply systems. The fact of being materials that are not affected by corrosion has increased considerably the range of its application. The first synthetic materials to be used for water piping installations were the polyvinyl chloride, abbreviated as PVC, and the polyethylene of low, medium and high density designated, respectively, for LDPE, MDPE and HDPE, however its low resistance to high temperatures conditioned its use for hot water piping networks. To overcome this limitation was developed the chlorinated polyvinyl chloride, known as CPVC, obtained by changing the chemical nature of PVC, and the cross linked polyethylene, known as PEX, obtained by cross linking of HDPE.

Other thermoplastic materials emerged in the market of water piping systems, some of them more succeed, among which we highlight the polypropylene copolymer, known as PP-R, and other less prominent, as is the case of polybutylene, known as PB, or the resins of acrylonitrile-butadiene-styrene, known as ABS.

In the last two decades we have seen an increase in the use of thermoplastics for hot and cold water piping systems installations. In these systems, connection fittings are not always of the same material as the pipes, turning up quite often the use of copper alloy fittings.

The technological evolution of the materials used for water piping installations has been done primarily in terms of characteristics, properties, and joining techniques. The evolution of the joining techniques between pipes, and between pipes and fittings, has evolved in order to minimize the intervention of the installer, reducing the working time and lowering the cost of manpower.

Respectively, two metallic piping systems, two plastic piping systems and a composite piping system, all with specific application for drinking and sanitary water supply networks. It will be chosen some of the piping systems with wider application in Portugal, and it will be emphasized in each chapter, the main advantages and limitations of the systems, and described the main joining techniques between pipes and pipes and fittings.

2. Issues and investigation of plumbing system in Public and Residential Buildings

In order to grasp the application of practical cases and verify plumbing system data, first, we performed field investigations to see plumbing system-related issues in buildings. The first observation in the area of BMC Mumbai the following photographs are taken for area of BMC Building then followed by a residential building and a hospital building. The residential building also taken from the Mumbai region and hospital building is taken from the Miraj area.

Pipe Corrosion is the thinning of the wall of a metal pipe, caused by electrolysis (chemical breakdown by electric current), rust, or acidity of the water. Galvanic corrosion (resulting from a direct current of electricity) occurs in a plumbing installation system that includes two different kinds of metal pipe, such as galvanized pipe and copper pipe. In both the above photos we can see the rusting of plumbing pipes and due to which there is leakage problem.
### Table No. 1 Comparison of plumbing material

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Epoxy Coating</th>
<th>Plastic</th>
<th>Copper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosion Resistance</td>
<td>Corrosion proof</td>
<td>Corrosion proof</td>
<td>Some risk of corrosion</td>
</tr>
<tr>
<td>Taste &amp; Odour</td>
<td>Compounds released from this material in drinking water plumbing may give a chemical or solvent taste or odour to the water.</td>
<td>Compounds released from this material in drinking water plumbing may give a chemical or solvent taste or odour to the water.</td>
<td>Compounds released from this material in drinking water plumbing may give a bitter or metallic taste or odour to the water.</td>
</tr>
<tr>
<td>Health Effects</td>
<td>Material meets EPA Standards. There is a very small chance that compounds from this plumbing material that are released into drinking water may lead to microbial growth in water. Microbial growth may cause severe illness.</td>
<td>Material meets EPA Standards. There is a very small chance that compounds from this plumbing material that are released into drinking water may lead to microbial growth in water. Microbial growth may cause severe illness.</td>
<td>Material meets EPA Standards. There is a very small chance that compounds from this plumbing material that are released into drinking water may cause vomiting, diarrhea, stomach cramps, and nausea.</td>
</tr>
<tr>
<td>Convenience Of Installation</td>
<td>No need to tear into the wall and/or floor. Installation takes around 4 days.</td>
<td>Some sections of wall for installation. Installation takes 5-6 days.</td>
<td>Need to tear into the wall and/or floor to replace the existing system. 7-9 days required for installation.</td>
</tr>
<tr>
<td>Proven Performance in market</td>
<td>Less than 10 years in the market</td>
<td>Less than 20 years in the market</td>
<td>More than 50 years in the market</td>
</tr>
<tr>
<td>Cost (labor + material)</td>
<td>9,000 – 14,000 depending on the size of house</td>
<td>6,500 – 13,000 depending on the size of house</td>
<td>9,000 – 16,000 depending on the size of house</td>
</tr>
<tr>
<td>Warranty</td>
<td>Warranty is 15 years for the material.</td>
<td>Warranty is 10 years for the material.</td>
<td>A 50 year manufacturer’s Warranty applies. Some exceptions apply.</td>
</tr>
</tbody>
</table>

3. Comparison of plumbing material

Figure 2 Region BMC Mumbai

Figure 3 Residential Building (Vishrambagh Sangli)
4. Cost comparison of plumbing system considering time factor

Table No. 2 Estimation cost Comparison of plumbing material

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Quantity</th>
<th>Cost at Building Construction</th>
<th>Nowadays</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipes</td>
<td>152</td>
<td>20520</td>
<td>364</td>
</tr>
<tr>
<td>Connection s</td>
<td>48</td>
<td>8400</td>
<td>172</td>
</tr>
<tr>
<td>Stop Cock</td>
<td>36</td>
<td>3780</td>
<td>201</td>
</tr>
<tr>
<td>Other Fixtures</td>
<td>50</td>
<td>4250</td>
<td>250</td>
</tr>
<tr>
<td>Total Cost Of Plumbing</td>
<td>36950</td>
<td>764</td>
<td>20</td>
</tr>
</tbody>
</table>

The Estimation is considered for 1824 Ft Plumbing Work For Three Wings

Table No. 3 Estimation cost Comparison of plumbing material

<table>
<thead>
<tr>
<th>Cost at Building Construction</th>
<th>Epoxy Coating</th>
<th>Plastic</th>
<th>Copper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cost</td>
<td>36950</td>
<td>76420</td>
<td>46720</td>
</tr>
<tr>
<td>Percentage Difference</td>
<td>–</td>
<td>106.820</td>
<td>26.441</td>
</tr>
</tbody>
</table>

5. Conclusion

Despite the rapid technological evolution of the systems used for sanitary water installations, as a result of the recent emergence of new piping systems that seek the high performance with the low installation time and cost, we can conclude that there are no perfect water piping systems. There are, however, systems that seem to be more suitable or appropriate for a particular type of installation. In fact, if it is intended to install a sanitary piping network with high extension, subjected to a high thermal gradient, for which the mechanical resistance to external loads is an important issue, a metallic water piping system, as copper, galvanized steel or stainless steel, is a solution almost unbeatable. However, if it is intended to install a sanitary piping network with a complex design, with low thermal losses, for which the cost of a skilled installation has a considerable weight, the plastic water piping systems are easier to install. It is expected, in future, that the evolution of the sanitary water piping installations won’t be at the level of the materials and technologies, but especially at the level of the installation methods.

Leaks in piping behind walls or partitions or under floors may be troublesome to locate, because moisture indicating a break may not appear near the place where the water is being lost. Water from a leak will often run along a horizontal run of pipe, or a beam, and drip off a long distance from where it started. Water naturally runs down a vertical section of piping, perhaps to appear far below the actual leak.

The water piping networks without any kind of accessibility for the repair are doomed to failure. All water piping systems should be installed inside an accessible duct, or inside a false ceiling that covers up the exposed piping network. The construction of technical galleries, ducts or removable ceilings in buildings requires a straight coordination between the various agents that operates in building design, with particular emphasis on the architect, a fundamental part in the design of spaces, and the civil engineer, that designs the water piping systems.

It can’t be excluded from this team, the municipal services. These entities have, in many cases, their own legislation that rules beyond the requirements contained in the national regulations. From the understanding that this “triangle” can achieve in this field, the quality of construction can be enhanced.

6. References


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