Case Study: Piping System failures – cPVC in Premium residential society

Background

- A high rise, premium Apartment Block on Noida Expressway.
- 70,000 sqm area, Project cost of Rs 750 Crores
- The Society has 12 storey buildings, 17 towers and 4 flats/ floor. Total of about 600 flats.
- Ultramodern, 3&4 bedroom apartments and Penthouses with world class specifications
- Prime features - High-tech security, dedicated parking, **Modular Kitchen with piped gas supply,** Wooden Flooring, **Ultra Modern Toilets, In-home Maintenance services etc.** Moreover there is an in-house club with five-star offerings.

Current Status

- Flats being Handed over to the clients. Residents living in the complex for about 1 year now.
- Piping of CPVC (both external as well as in the toilets)
- External cPVC pipes running through shafts.
- Reputed cPVC manufacturer has supplied the piping system.

Issues informed to the plumbing experts

- All Flats are having problem of water seepage.
- The main pipes are getting cracked, joints leaking and the maintenance offices being flooded with complaints to rectify the problems everyday.
- The initial savings in piping material has cost the builder huge amount of money in repair and loss of reputation

Problems identified by the Project Manager

- Pipes getting deformed
  - Adequate supports not provided.
- Pipes are brittle, even a small stone lying on some slab when it falls leads to pipe breakage
- The joints are leaking
  - In main pipeline in all the towers
  - In the toilets
  - Each and every of the 600 flats have complained.
- High flow rate (no PRV)
- Joints are not durable
- When **Taps/ Fittings** are tightened, the pipe cracks in the toilet
- Even the repair is not reliable
- Management feeling helpless and groping in dark for solutions

Technical Analysis

- CPVC has highest thermal expansion coeff.
  - For 50ºC change in temp, the 30m cPVC pipe expands by 15cm

- cPVC is brittle and at low temperature, the thin walled system is extremely brittle. They may crack even on dropping from height
- CPVC pipe and fittings are subject to cracking during earthquakes.
- Permitted flow rate is 2m/sec.
- Loud noise can be heard when water flows in some cases.
- Not all the technical issues are discussed with the Builders/ Management and decisions are made on some sales pitch

Possible Reasons for the cPVC pipe Failure

1. Thermal Expansion

- The Pipes would have been installed in Summers when the temperature was nearing 45C
- In winters (temp nearing zero C), the pipes get shrunk, leading to buildup of the stresses.
- Design to address the Expansion issue was not done.

2. Joining

- If there is too much glue applied it can actually dissolve the pipe and cause a failure.
- The jointing by solution can't withstand these stresses and start leaking.
- Repairs may temporarily provide relief but in the summers, reverse situation will happen.

3. Inadequate Supports

- The cPVC Pipes need support at every 4' otherwise it leads to problems

4. Brittle Material

- cPVC is a brittle material. It is not suitable for external usage in extreme weather conditions

5. Connectors

- Need to use Brass connectors for threaded fittings which is expensive

6. Future Problems

- High flow rate will soon aggravate the problem as the wear of pipe over next few years

7. Freezing Waters

- The freezing water temperature will make the pipes brittle. Need to use it carefully.

8. Ultravoilet Rays

- The cPVC pipes need to be protected from direct sunlight / UV Exposure.

9. Ageing

- As cPVC pipes age, the pipes become brittle and must be protected from physical shocks to avoid failures

10. Toxic

- When cPVC is burned (eg house fire), it emits a deadly toxic fume.

11. Installations

- Pipes if not installed properly are prone to Environment Stress Cracking

12. Damage from Rodents

- For reasons known only to rodents CPVC is highly subject to damage from rats, mice, squirrels and Opossums and may not be a good choice of materials for running under a structure with a crawl space or raised foundation, especially in rural areas

References:

- This is based on the analysis of the site and actual discussions with the management of the builder.
- The reference data is taken from various sources on the net and the websites of the cPVC pipe manufacturers.