

Grouts & grouting

Material used for filling the space or gap between the base or base plate of a column, trestle, machine etc. and the top surface of its foundation is called grout and the process of filling grout is called grouting. The main objectives of grouting is to maintain alignment of the erected structure or equipment etc. accurately as well as to render the combination of it and its foundation monolithic. In case of structures like column, trestle and suchlike, this monolithic nature helps uniform transfer of load and in case of a machine foundation it also imparts dynamic stability to the combination. Various other kinds of grouts are also available for various other purposes.

Grouts are integral elements of virtually all construction projects, especially industrial projects. Two of the most widely used grouts in such projects are: a) grouts prepared in-situ with Ordinary Portland Cement (OPC) and b) Ready to use or pre-mixed or pre-packed non-shrink grouts. Grout prepared in-situ is usually a simple mix of OPC & good quality, well graded sand. Sometimes, small sized stone chips are also added as described later in this post. The ratio of cement to sand normally varies from 1:1 to 1:2 as per requirements. These grouts are usually used in ordinary structures. For large machine/equipment foundations, tall or heavy structures etc., ready-to-use grouts, which come in many varieties with diverse characteristics meant for diverse purposes, could be a much better choice from strength, durability or even workability point of views. Few quite useful points about these two types of grouts are briefly discussed here.

Grouts prepared in-situ with OPC:

Water to cement (w/c) ratio for these grouts should be kept as low as possible while ensuring the required workability too. In other words, w/c ratio should be just enough to render the mix flowable which could be ascertained from trial mixes. Restricting this ratio is of utmost importance from both strength & durability point of views.

For gaps of thickness of 1" and above, especially for large or heavy structures, it is appropriate to use good quality stone chips of size 6mm & downgraded for better performance. The ratio of cement : sand : chips may be kept at 1:1:2.

Unlike non-shrink ready-to-use grouts, these ones tend to shrink in volume after hardening. Since, the extent of shrinkage is a function of water content of the mix, it is quite necessary to maintain a low w/c ratio.

W/c ratio usually needs to be increased as the gap thickness increases. As a simple rule of thumb for these grouts, when the gap thickness is more than 1" thick, the cement to sand ratio may be kept at 1:2 & max. w/c ratio restricted to 0.52. When the same is less than 1" thick, the ratio may be adopted at 1:1 with the max. w/c ratio restricted to 0.45.

For mixing purpose, revolving type, tilting mixer of suitable capacity may be used. For preparing small quantity of grout, large mixer drum is not suitable as proper mixing won't take place. Mixing needs to be done for a minimum period of 3 minutes & mixing location should be as near as possible to the location of grouting. Freshly mixed grout

should be placed within 15 – 20 minutes of completion of mixing in order to maintain quality & the quantity to be mixed may be estimated accordingly.

Grouting operation should preferably be done from one direction only in order to avoid air getting trapped within. The grout needs to cover all shims to be retained and completely fill the annular spaces of all anchor bolts.

Once sufficiently set, the formwork is removed & excess grout, if any, is trimmed. Top surface of grout is float-finished smooth and sloping mildly outwards.

Curing for these grouts may commence immediately after a day of completion of grouting and continue for a week.

Regarding testing of cement-sand grouts prepared in-situ with OPC, cube compressive strength test is the usually adopted one even though there are few other tests as well. No of cubes to be taken depends on quantity of mix and is usually prescribed in relevant quality assurance documents. As an approx. rule, 4 cubes may be taken for first 5 bags of grout and additional 2 cubes for every additional 5 bags or part thereof. Minimum 4 cubes must be taken even for small quantities. The freshly filled cube moulds are kept undisturbed for 24 hours after which the grout cubes are removed from moulds and submerged in water immediately. These are then taken out of water just prior to testing. Of the total number of cubes taken, half may be tested for 3 days strength and the remaining half for 7 days.

The size of the cube moulds is 70.6 mm as per IS:4031. Usually 3 & 7 day compressive tests are the most widely referred ones. However, often 1 & 28 day tests are also conducted. The minimum cube compressive strength for various periods are usually prescribed in relevant quality assurance documents. As a guideline, 3 & 7 days compressive strength for these grouts should not be less than 16 N/sq.mm & 22 N/sq.mm respectively.

Surface preparation prior to pouring grout involves more or less similar activities for all kinds of grouts. The top surface of foundation should be rendered rough in order to develop strong bond with fresh grout. The surface should be thoroughly scraped to free it from dirt, loose particles, oil, grease, mortar lumps etc. and must be wetted thoroughly for preferably a couple of days prior to commencing grouting. Just before pouring grout, excess water, if any, should be removed. Pockets, if any, may need to be vented to facilitate full penetration of grout.

Pre-packed, ready-to-use grouts have many advantages over ordinary grouts prepared in-situ with OPC. One need not worry about procuring ingredients or mix proportion etc. as everything comes ready in bags and it just needs to be mixed with water or the prescribed fluid as per manufacturer's literature. These grouts are readily available with non-shrinking or free flowing characteristics, eliminating issues like shrinkage of grout, workability etc. substantially. Many of these grouts are tailor-made for specific purposes offering plenty of varieties to choose from for various purposes. Most of these compounds offer quite high strength and could be chosen as per strength criteria as well. Procedures

for storing, mixing, grouting, testing etc. are usually well laid down in manufacturer's specifications and one just needs to follow those carefully.

Some useful points about these grouts are briefly discussed here:

While purchasing packaged grout, relevant test certificates from the manufacturer should be scrutinised & collected.

Grout's brand name, type, date of manufacture, batch number, date of expiry etc. usually come clearly printed in the bags containing grout. The same should be checked properly.

Grout bags should be stored in a dry & cold place protected well from moisture. Well stored grouts can be used upto 6 months from the date of manufacture.

Similar to w/c ratio in the case of grouts prepared in-situ with OPC, these grouts correspond to water to powder (w/p) ratio.

Restricting w/p ratio is quite important and normally the manufacturer's specifications prescribe clear guidelines on it.

Some structures may call for grout of flowable consistency while some other may need grout of pourable consistency.

Flowable grout has higher w/p ratio as compared to pourable one. In other words the former is more workable than the later. A smaller or complicated gap could ask for a flowable one rather than a pourable one from workability point of view.

The optimum w/p ratios for both flowable & pourable conditions of a grout mix and the corresponding minimum cube compressive strengths for 1, 3, 7 and 28 days are usually clearly specified in manufacturer's technical literature or similar quality assurance documents. Tests are conducted accordingly as part of quality control measures.

W/p ratio prescribed should be strictly adhered to. Trial mixes may be conducted in order to confirm desired fluidity or workability, strength etc. with prescribed w/p ratio.

In certain cases it may become quite necessary to use workability enhancing admixtures. However, such additives should only be used if manufacturer's technical literature on the product mentions provision for the same.

