STUDY ON THE USE OF "DOWEL LOAD TRANSFER SYSTEM" FOR JOINTED PORTLAND CEMENT CONCRETE PAVEMENT (PCCP)

Load Transfer is the capacity of a joint or crack to distribute an approaching load by shear from one slab to the adjacent slab. This can be achieved with the help of aggregate interlock and steel dowel bars. When a load passes on a joint or crack, both the loaded and unloaded slab deflect in equal amount which results in a lower joint deflection. However, when there is zero load transfer efficiency, the slabs deflect singularly which causes high stresses at their edges and corners. One of the main issues or problem arising from jointed concrete pavements is joint failure. The rapid growth in vehicle traffic and heavy loads especially cargo trucks contribute to the increase in stress experienced by the road pavement which may result into fracture of aggregates. Consequently, the aggregate interlock decreases together with the load transfer capacity of the joint as the time goes by which will result into faulting and the deterioration of pavement slabs. To address this problem, a new load transfer assembly at every weakened plane joint is introduced in this study to replace the conventional dowel bars. The introduced load transfer assembly is being studied and monitored by the Bureau of Research and Standards. Two-small-scale pilot trials were constructed along R-10 in Navotas City and Tondo, Manila. To monitor the performance of the new technology, non-destructive tests are being done on a regular basis. In relation to the load transfer capacity of the joints, no major faulting was observed. This technology may prove useful in areas where heavy loading is experienced like port areas and heavy cargo truck routes. Furthermore, this technology has the potential to prolong the lifespan of the road, thus, reducing the maintenance and reconstruction costs and offsetting the initial investment that additional steel bars bring.

One of the major advantages of using a rigid pavement is the low deflection under traffic loadings due to the high modulus of elasticity of their surface course. Typically, Portland Cement Concrete Pavement (PCCP) is built with separating joints between slabs to provide extra space for movement due to expansion and shrinkage. One key aspect of transferring traffic load is the aggregate interlock across the joint. As the pavement gets old, the efficiency of aggregate interlocking drastically decreases and the joint faces lose friction. In addition, poor loading transfer causes pumping which is a major distress in PCCP. The ion-crease in heavily loaded vehicles does not help the case. In order to prevent this from happening, efficient load transfer system is put in place that will bond the adjacent slab together as vehicle loading passes the joint. Dowel bars are used nowadays as a permanent load transfer tool in concrete joints.

To determine further the performance as well as the adoptability of the new technology, the Department of Public Works and Highways through the Bureau of Research and Standards constructed two (2) small-scale pilot trial projects incorporating the "Load Transfer System" for jointed Portland cement concrete pavement in the road construction. Also, conventional construction of concrete pavement was also implemented for the comparison of the new introduced technology.

While the technology has been studied and used in other countries, product evaluation (laboratory and field) were done to determine whether the said technology is feasible and effective in the Philippines given the traffic and climate conditions in the country.

For the first pilot trial, very little amount of controlled section (14 linear meters) was constructed that will be used for the comparison and evaluation of the constructed pre-trial project.

In the second pilot trial, it was observed that several blocks of the existing road exhibit severe multiple cracks and transverse cracks caused by continuous exposure to the heavy load brought by the trucks passing thru on a daily basis. Spalling also was noted on some blocks of the road section.

Both pilot trial projects used the same construction methodology as the conventional Portland cement concrete pavement being constructed.

Based on the laboratory tests being conducted, it is clearly determined that the technology improves its inherent physical properties and characteristics of the resulting concrete pavement. Thus, this technology has the possibility to prolong the life span of the pavement.

Furthermore, the comparative cost analysis revealed that load transfer system is expensive to use due to the large amount of the fabrication and installation of dowel bars with metal epoxy coated in basket assembly compared to the conventional concrete pavement being used to the government projects. However, the technology has a high durability that reduces repair/maintenance works which will lead to more infrastructure development and prolonged life cycle of the projects nationwide.

The technology is not new to the Department. In fact, a study has been made by a team of consultants and it recommended a load transfer assembly to be used in arterial and secondary roads leading to ports. The inclusion of dowel bar assembly in the minimum design standard for PCCP has been prescribed in Department Order (DO) No. 40, series of 2014. However, several implementing offices and contractors have stressed issues regarding the construction methods and bar supplies and the technology has been put on hold. For areas with tight space, concrete pouring might come up as an issue as the dowels basket assembly at every weakened plane joint needs to be put in place prior to pouring. Adjacent lane is used as a dock for concrete mixers as pouring takes place. For road networks without necessary space needed, traffic rerouting must be implemented.

As part of the mandate of the Department to ensure the quality and safety of the roads, re-searches on different technology are continued to be done by the Bureau and one of them is the load transfer assembly. Based on the results of the monitoring, the new technology might have a positive effect on the durability of the joints in roads where there is huge heavily loaded vehicle traffic. As previously noted, no pumping or major distresses observed on the road. Despite the type of loading that the road experiences on a daily basis, it suggests that there might be an excellent load transfer between the joints of the pavement. However, further monitoring is recommended so that the long-term effect of the technology will be completely realized.

It is a known fact that issues on the supplies and costs will come up as this technology is implemented. While the cost of the road will increase, the durability of the road also in-creases, possibly eliminating the maintenance or reconstruction cost. The technology has the possibility to prolong the service life of the pavement especially for areas with heavy loadings.