

Tibet Cement Silo Structural Strengthening using TYFO® Fibrwrap® Systems



Lhasa, Tibet SAR
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Located in the outskirts of Lhasa, capital of Tibet at an altitude of more than 4000 meters above sea level, a local cement production silo showed signs of cracks and severe concrete spalling. The reinforced concrete silo measured 44 meters high with an external diameter of 15.6 meters. After inspection and structural analysis, it was concluded that the silo was deficient in hoop reinforcement. This under design caused structural cracks running vertically in the mid section and the lower section of the silo. Other than structural design considerations, the silo's maximum internal operating temperature was 120 deg C with average temperatures of 100 deg C. Also, the high abrasive effect of the cement during discharge on the internal walls was another major consideration. Coupled together, it was postulated that these factors were the cause of the concrete deterioration leading to widespread spalling.

For the design calculations, the shortfall in hoop resistance was tabulated at various levels along the silo's height and compensated for by the TYFO® SEH51 Fibrwrap® System. A certain amount of over provision was necessary in consideration of the high operating temperature. An in-situ test was further proposed on a trial Fibrwrap® area to ensure that the System could withstand such high operating temperatures. As for abrasion, it was deemed that the bond strength of TYFO® S epoxy to a well prepared concrete substrate should be able to withstand the abrasion caused during the cement discharge.

During installation there were many difficulties and challenges to overcome. Work commencement had to be delayed as some of the workers suffered from acute altitude sickness and trucking of materials to the site location took longer than expected due to the remoteness of the site as well as the rough terrain en-route. Therefore safety was a prime consideration and sufficient rest was given to workers so as to ensure sound workmanship which was extremely critical since any under saturated composite or under primed surface would certainly delaminate under the silo's extreme operating conditions. The smallest delamination would choke the silo's discharge chute (which contains a sieve) and thus necessitate another costly shutdown to facilitate remedial works.

The in situ 100 - 120 deg C temperature test was performed and TYFO® SEH51 composite did not show the slightest visual or physical deterioration. The works proceeded smoothly from thereon and upon completion, it passed the engineer's first round of inspection and the silo was able to resume production on time.

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