- Element forces and moments
- Deflection plots
- Stress contour diagrams

Table 5: Comparison of failure stresses (normal and shear stress) from manual and ANSYS

Sizes	*Ul Kn*	*Experimental normal stress (n/mm2)*	*Ansys normal stress(n/mm2)*	*Ratio (σe/σa)*
S-M25	6.000	7.445	6.615	1.125
M-M25	10.150	8.037	7.565	1.062
L-M25	16.500	7.660	8.511	0.900
S-M50	6.450	6.384	4.810	1.327
M-M50	11.150	7.009	5.284	1.326
L-M50	18.500	6.910	5.213	1.325
S-M75	6.150	6.181	7.464	0.828
M-M75	11.000	6.910	8.369	0.825
L-M75	17.000	6.360	7.691	0.826

Table 6: Comparison of failure stresses (normal and shear stress) from manual and ansys

Sizes	*UL Kn*	*Experimental Shear Stress (n/mm2)*	*Ansys Normal Stress (n/mm2)*	*Ratio (τe/τA)*
S-M25	6.000	0.667	0.540	1.235
M-M25	10.150	0.717	0.658	1.089
L-M25	16.500	0.683	0.637	1.072
S-M50	6.450	0.565	0.464	1.217
M-M50	11.150	0.620	0.510	1.215
L-M50	18.500	0.612	0.503	1.216
S-M75	6.150	0.416	0.500	0.832
M-M75	11.000	0.516	0.561	0.919
L-M75	17.000	0.475	0.515	0.922

UL = ultimate load,
σ_e = Experimental normal stress,
σ_A = Ansys normal stress,
τ_e= Experimental shear stress
τ_A = Ansys normal stress

It is observed that the ratio between normal stress from experimental and Ansys varies from 0.900 to 1.125 for M25 grade concrete, 1.325 to 1.327 for M50 grade concrete and 0.825 to 0.828 for M75 grade concrete and also observed that the ratio between shear stress from experimental and Ansys varies from 1.072 to 1.235 for M25 grade concrete, 1.215 to 1.217 for M50 grade concrete and 0.832 to 0.922 for M75 grade concrete.

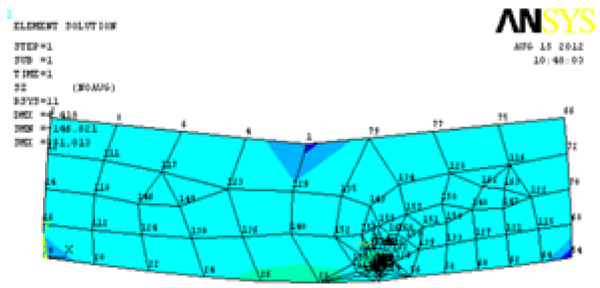

Figure 8: Stress Intensity in the Beam in Ansys

7. Conclusion

Based on the tests on twenty seven notched concrete beam specimens, the following conclusions have been drawn:

1. It is observed that, failure stresses (normal stresses and shear stresses) decreases with increasing of beam sizes.
2. It is also observed that, stress intensity factor increases with increasing in beam sizes for all grades of concrete.
3. It is also observed that, fracture energy increases with increasing in beam sizes for all beams.
4. It is also notice that, the larger the beam, the more leaned towards the load point the crack trajectory was.

8. Future Developments of SFRHSC

SFHSC has passed from a new material to one that became successful and widely applied because of its mechanical properties and advantages over the conventional concrete. The current review has tended to emphasize various aspects of SFHSC usage. However it would not be complete without mentioning the problems and limitations, associated with the material. Most of the problems are associated with producing the SFHSC mix (mixing, handling, bailing problem, etc.) And it's casting. However, it is possible to overcome these problems by using modern technologies and equipment. For example, devices, dispensing fibers automatically, are used to limit balling.

In the hardened state, fibers pose a few additional problems. One of them is that steel fibers corrode if cracking occurs. Corrosion decreases the positive effect of fibers. A question how long steel fibers will last under specific conditions is still important. The problem is positively addressed by the development of fibers offering corrosion resistance by their chemical composition. Finding alternative ways is one of the directions for further applications of SFHSC.

Concrete mix properties, yielding best fibers' location and most effective action in hardened SFHSC, can be successfully predicted at the design stage. The idea of two-layer beams, in which SFHSC was proposed to be used just in the compressed zone, is aimed at decreasing the fiber content and consequently the cost of the bending element. Understanding that stresses are not uniformly distributed along the compressed zone, it is more logically to have higher fiber content at the part of the compressed zone, where higher stresses appear. However, even modern techniques don't enable to change the fiber amount during the casting process. Therefore, today the fiber content is determined by the maximum tensile stress in concrete members, resulting in relatively high fiber expenditure. Developing appropriate techniques for control and varying the fiber content during casting of SFHSC elements would allow more effective fiber placement and lower cost of SFHSC elements. If the optimal amount of fibers could be regulated during casting, a further step for improving the performance of SFHSC could be more accurate design of structural elements using modern finite elements software allowing taking into account variations in real materials properties, various load cases and considering available data for proper design. The calculation results could be transmitted to a concrete casting system for addition of a required optimal fibers' content at each layer.

Using nondestructive techniques in real time during casting would allow obtaining a feedback for online prediction of hardened SFHSC properties. For this reason neural networks and modern sys- tem identification techniques may be also employed. Using mathematical models, applied for experiments' planning could enable to correct the fiber content online based on the predicted SFHSC properties.

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