BLAST RESISTING CONCRETE WALLS

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ABSTRACT

Today people around the world wake up, eat, live and sleep with terrorism. It has become a global menace. As a citizen lives in a country hit by a civil war for over three decades gave me motive and courage to set off this project. The project was basically planned to carry out in two parts, i.e. the literature survey and the experimental investigation. Initially a comprehensive literature survey was carried out to cover the several areas.

As terrorism is the main reason to for this project to exist, the literature survey was started off with an insight view of terrorism, its motives, methods and objectives of terrorist organisations. Later the survey was expanded to explosives and weapons frequently used by the terrorists. At the next stage of the literature survey, a review was done on the existing knowledge of blast resisting designs followed by a study on the various structural responses to blast loadings. The literature survey was further extendedto design of blast resisting structures and finally to design of elements to resist blastloadings was also completed. As a measure to increase the resistance to blast loadings, important characteristics of steel fibre and welded meshes were also studied.

The experimental investigation of the project was directed to find solutions to two situations, in battle field or terrorist attack. First series of tests of the project were concentrated on close range high explosive detonations. Unfortunately, this part of the project had to be abandoned due to unavailability of TNT explosives in slab form. This brought to the abrupt end to the test series one of the project.

The second series of tests were focused more on a military situation, where terrorist fire with RPG 7 at bunkers. After the testing, it was revealed that the designed concrete panel might barely withstand the RPG 7 fire. The reason for this may be the fact that the effects of small steel balls were not considered in the design. Only the amount of explosives and the distance from the centre of the RPG 7 mortar to panel were considered

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a	acceleration
A_d	area of diagonal bars at the support within a width b
A_s	area of tension reinforcement within a width b
A_s'	area of compression reinforcement within a width b
A_v	total area of stirrups in tension within a distance s and a width b
b	width of flexural member
d	depth of beam
d	distance from extreme compression fibre to centroid of tension reinforcement
d'	distance from extreme compression fibre to centroid of compression reinforcement
d_c	distance between the centroids of the compression and tension reinforcement
DIF	dynamic increase factor
E	modulus of elasticity
E_c	modulus of elasticity of concrete
E_s	modulus of elasticity of reinforcement or steel section
F	coefficient for moment of inertia of cracked section
f'	stress
f'_{dcu}	dynamic ultimate compressive strength of concrete at 28 days
$F(t)$	blast load from idealized triangular pulse
f_{cu}	static ultimate compressive strength of concrete at 28 days
f_{dc}	dynamic design stress for concrete
f_{ds}	dynamic design stress for reinforcement or steel section
f_{du}	dynamic ultimate stress of reinforcement or steel section
f_{dv}	dynamic design shear stress for steel section
f_{dy}	dynamic yield stress of reinforcement or steel section
f_u	static ultimate stress of reinforcement
f_y	static yield stress of reinforcement
H	span height
I	moment of inertia
i	unit positive impulse

I_c	moment of inertia of cracked concrete section of width b
i_r	unit positive normal reflected impulse
K	stiffness
K_E	equivalent elastic unit stiffness
K_{LM}	load – mass factor
m	mass of human subject
M	mass of the structure
M_n	ultimate negative moment capacity
M_p	ultimate negative moment capacity
n	modular ratio
p	pressure
P	load
p_{max}	peak pressure
p_r	peak positive normal reflected pressure
R	range from charge centre
r_u	ultimate unit resistance
S	plastic section modulus
β	coefficient applied to toilet load P to determine dynamic reaction V
t	time
T	natural period of vibration of structure
t_d	duration of idealized blast load
t_m	time to reach maximum dynamic displacement
T_s	positive phase duration
V	support reaction
v_c	ultimate shear stress permitted in an unreinforced concrete web
V_d	ultimate direct shear capacity of the concrete of width b
V_s	shear at the support per unit width
v_u	ultimate shear stress
W	mass of spherical TNT charge
x	displacement
X	deflection

x depth of neutral axis below extreme compression fibre in a flexural member

X_e equivalent elastic deflection

X_m maximum transient deflection

x_{max} maximum dynamic displacement

Z scaled distance

Z elastic section modulus

α coefficient applied to toilet internal resistance R to determine dynamic reaction V

γ_m partial safety factor for material

δ side – sway deflection

ε Strain

ε strain

θ support rotation angle

ρ density

ρ_s tension reinforcement ratio

ρ'_s compression reinforcement ratio

μ ductility ratio

ω natural circular frequency of vibration