DEBRIS OPERATIONAL GUIDANCE:
DAMAGED CONCRETE AT WILDLAND URBAN INTERFACE FIRES
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Background

The purpose of this debris removal guidance is to assist field operational decisions under a CalRecycle structural debris removal program in removing impacted concrete. Working around concrete structures in areas impacted by ash and debris requires significant careful and deliberate effort with equipment and hand labor to remove contaminants or the contractor risks leaving contaminants behind. Here are life hazards as well when working around post tension slabs. Demolition of post-tensioned concrete structures presents a unique set of safety issues because the cables or rods are not bound to the concrete and can act like a stretched rubber band. When the concrete is broken, the cable may snap violently causing the imbedded anchors to become projectiles. Additional there are risks that other aspects of the home site could be damaged by the removal efforts as well. Generally, all materials including concrete in areas directly impacted by the fire and subsequent ash and debris will need to be removed.

As with all construction work, a number of field decisions must be made by qualified individuals to complete debris removal. This guidance is designed to operate in accordance with the Standardized Emergency Management System (SEMS) by using the Incident Command System (ICS) for field response. All field personnel will use this Damaged Concrete Guidance to ensure consistent safe practices are followed. Common issues are addressed below; if questions arise about a concrete structure/wall/pad in the field, please refer to the next level of command for further guidance. Field training is always available to assist in decision making. CalRecycle utilizes the following concrete operating procedures relative to situations encountered during debris removal from residences following catastrophic wild fires.

Discussion

The average house fire burns at a temperature of about 1,100 degrees Fahrenheit (ºF) but can reach in upwards of 1,300ºF depending on certain conditions such as wind and building construction. The longer concrete is exposed to heat, such as that generated by a large-scale wildland, urban interface fire where little to no structural firefighting suppression occurs, the more damage the concrete sustains.

Basic behavior of concrete at high temperatures is well established in textbooks and discussed in the literature. Important factors in assessing the damage to concrete are the rate of heating and the duration of exposure to high temperatures. At slightly above 212ºF, free water in concrete begins to evaporate rapidly. When concrete reaches about 350ºF, a significant amount of chemically bound water is released. When concrete temperatures reach above 750ºF, the residual compressive strength typically drops by 50 to 60% and the concrete is considered fully damaged.

Existing footings, slabs, and foundation systems in fire-destroyed buildings should not be and/or not typically permitted to be re-used. The effects of intense heat and fire on a foundation system renders the foundation unusable, or impractical for re-use. A long burning fire can generate enough heat to damage and weaken the concrete and steel reinforcement bars in footings, slabs, and footing stem walls. Even though concrete is non-flammable and offers fire protective

qualities for preventing the spread of fire, it loses most, if not all of its structural strength characteristics when exposed to extreme heat from a long burning fire.

Foundation anchorage hardware (steel bolts and hold-down anchors) are typically lost or severely compromised during a serious fire and cannot be replaced or repaired without significant expense. Installing replacement anchors in an existing footing is labor intensive and requires special inspection during installation, which can add substantial cost. Replacement anchors for hold down hardware must be re-engineered and are difficult and expensive to install in existing concrete footings. Plumbing pipes and electrical conduit embedded in the concrete is usually destroyed or heavily damaged during a fire. Repairs and replacement of pipes and conduit in existing foundations involves the removal and replacement of portions of the concrete that encapsulates them, which further compromises the concrete. This process usually involves the saw-cutting or jack-hammering out those portions of concrete containing pipes and conduit, removing and replacing the damaged pipes and conduit, and pouring the replacement concrete. This task becomes dangerous when dealing with a post tension slab damaged by a fire. Additionally, moisture barriers placed under concrete slabs can be destroy or damage by heat and fail to prevent water from impacting the structure.

Older foundation systems typically do not meet today's structural design requirements for earthquake safety or wind loads. This is especially true in cases where the original building was constructed prior to 1974. Current State Codes require that new buildings meet or exceed certain minimum design and construction safety standards. In most cases, compliance with these standards is difficult or impossible to verify in an existing foundation system because the foundation is below ground and the size, spacing, and location of steel reinforcement steel embedded in the concrete is difficult to determine.

Conclusion

While some professionals use color changes and hammer tests to assess residential, heat-damaged concrete and others use mechanical compression and shear testing, the California Department of Resources Recycling and Recovery (CalRecycle) considers all structural foundations to be destroyed by the heat from an unsuppressed structure fire. These slabs and foundations are no longer structurally sound and now considered debris. Some concrete structures such as retaining walls greater than four feet and piers, pilings, caissons, and horizontal structural will be left in place for slope stability. The IMT cannot guarantee these structures will be undamaged or are structurally sound. The owner should consult a license civil or structural engineer to determine the proper course of action to rebuild any concrete structures left by the IMT.

Finally, with the known amounts of carcinogens, heavy metals and asbestos in the ash and debris, structural slabs will need to be removed to assess the former building sites for residual ash contamination.

Should the owner wish to keep a structural foundation, the owner should not enter this public debris removal program and instead, contract with a private contractor to remove debris in accordance with local government requirements.

Technical Guidance

1. *General Discussion*
    a. All concrete or asphalt within the structural ash footprint will be removed. A distance of five feet from structural ash is used as a guideline. All concrete left in place will be made safe by cutting rebar flush or fencing retaining walls and/or pools. Generally speaking, if confirmation samples will be collected, then the concrete shall be removed. While cutting or breaking concrete, the contractor shall wear personal protective equipment (PPE), including eye and respiratory protection.

2. *Structural Slabs and Foundations*
    a. Required removal: Includes homes, cabins, mobile home slabs, barns, sheds, garages, other living structures and any concrete pad that was designed to hold a structural load. If the slab or pad was used to store vehicles or other commercial materials such as tires, building products, roofing titles, etc., the impacted slab must be removed.
    b. Exception: Well slabs or pads. To protect the well casing and the integrity of the well, remove only ash and debris by hand and leave concrete pad around the well casing. Protect well with temporary construction fencing. Use PPE.
    c. Exception: Former slabs or pads that only held firewood or other inert material will be left in place. These slabs may be from a previous structure that was removed and/or not damaged by a fire.

3. *Driveways*
    a. Undamaged driveways shall be preserved to the extent practicable. The goal is to provide a stabilized construction entrance for reconstruction.
    b. If the driveway is damaged or contaminated (e.g. burned vehicles) by debris removal equipment or haul trucks to the extent that the driveway is unsafe, the driveway will be removed to the extent necessary. Remove the driveway to the nearest concrete joint or five feet if asphalt outside the contamination or damage. All driveway cuts will be made using a concrete saw. Use PPE.

4. *Chimneys*
    a. Required removal: See asbestos survey requirements.
    b. Exception: Patio fireplaces will not be removed unless deemed unsafe due to fire related damage.

5. *Patio or other backyard features (such as waterfalls, sports courts, etc.)*
    a. Leave in place unless feature poses a physical hazard from fire related damage or impacted by ash and debris.

6. *Pools*
    a. Leave in place. In general, pools are not eligible for removal and will not be drained by the IMT. The contractor will place metal fencing completely around the pool where feasible and notify the homeowner. Should the pool be structurally built into the foundation/slab, the IMT will discuss removal options with the property owner and Contractor to determine the course of action. Debris may be removed from the pool depending on site circumstances. The owner should contact the local government for assistance or evaluation of pools due to possible vector and health issues.

b. Exception: Above grounds may be removed if the property owner wants the above ground removed. Pool water may be use as dust control if feasible.

7. *Walkways and private sidewalks*
   a. Leave in place.
   b. Exception: Unless necessary to remove for equipment access, covered in ash and debris, or damaged by equipment so that it is unsafe to walk on.

8. *Retaining Walls Less Than Four Feet*
   a. Leave in place unless covered in ash and debris or remove if the property owner wants the wall removed.
   b. Exception: If handwork cannot successfully remove the ash, remove wall and cut slope back to 2:1.

9. *Structural Retaining Walls Greater Than Four Feet*
   a. Leave in place. If connected to slab, make a cut with a concrete saw approximately 24 inches away from the wall. Notify owner that retaining wall is being left in place for erosion control and that the incident management team (IMT) has *not* evaluated the wall for structural integrity. Inform the local government the wall shall be evaluated by a licensed civil or structural engineer before reusing.
   b. Exception: If wall is unsafe and may collapse, remove wall and cut slope back to 2:1.

10. *Basements and Wine Caverns*
   a. Required to be removed. Once basements and caverns are removed, the Contractor will cut the slopes back to 2:1 and fence with temporary construction fencing.

11. *Footings*
   a. Required to be removed. Footings under the foundation will be removed.
   b. Exception: If footings are horizontal piers or other structural support below the slab, the concrete and/or steel will be cut/broken at the interface and rendered safe from tripping hazards.

12. *Caissons, Piers, Pilings, or Horizontal Structural Piers Under the Slab*
   a. Leave in place. Remove slab to grade minus 3/10 and cut rebar and other metal supports to the base of the concrete/steel piers/pilings.

13. Post Tension Slabs
   a. Required to be removed. All post tension slabs shall be removed by a qualified demolition contractor under a sperate work plan due to safety concerns. Workers should adhere to the recommended safe work practices and follow the prescribed procedures in the work plan. Demolition of any type of pre-stressed concrete structure requires extra diligence and awareness even for the most experienced workers.